Training of KRPs On Methodology of Teaching Science with Special Emphasis on Physics at Secondary Level for Himachal Pradesh

(15th –19th January, 2004)

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Regional Institute of Education, Ajmer
(National Council of Educational, Research and Training)
January 2004

PREFACE

Science is a rapidly growing subject. Therefore teaching of science demands continuous reassessment and periodic review of the contents and the method of teaching. The process of interlinking and interpreting the great world outside with the mind within the learner and the presentation of the content accordingly is realm of the method of teaching.

Students learn effectively when they are taught by such methods, which are synchronized with their capabilities, interests, experiences and mental levels. Also, the same method can not be implemented to teach all the topics of science. Even one topic may need incorporation of different methodology. It is necessary to plan and design different techniques, strategies and tactics to realise various instructional objectives. Hence, methods should be flexible according to teaching – learning situations. It should encourage active participation and reflective thinking of the students and it should facilitate to develop skills in the method and process of science.

Realizing the importance of different methodologies of teaching science, SCERT, Himachal Pradesh suggested a programme to train the resource persons of the state on the Methodology of teaching science with special emphasis on Physics at secondary level.

It is in this context that the present programme has been undertaken by RIE, Ajmer.

The training package consists of instructional material on different topics of science, especially Physics, through various methodologies. A variety of teaching strategies through exemplar lessons on project method, activity based teaching and concept map have been provided to enrich the teaching – learning environment. A description of Multimedia and its application have also been included.

Grading and evaluation principles are also given in the material.

Although this package has been developed for the KRPs of science for Himachal Pradesh, I trust it will be equally useful to all the teachers teaching Science at secondary level.

ACKNOWLEDGEMENT

I take this opportunity to thank Prof. A. B. Saxena, Principal, Regional Institute of Education, Ajmer for his valuable guidance, constant encouragement and support in carrying out the programme successfully.

I am grateful to Prof. H. C. Jain, Head, DESM for providing me academic guidance.

Thanks are due to Prof. K. M. Gupta, Dean of Instruction for his kind support. I am thankful to prof. K. S. Khichi, Head (now retired), DEE, Dr. S. K. Pranami, present Head, DEE and Dr. V. C. Gupta, State Coordinator of Himachal Pradesh and their department staff for helping me at different phases of the programme.

I am extremely thankful to the Director of Education, Himachal Pradesh for his worthy cooperation.

I owe a special debt of gratitude to Dr. K. C. Sharma and Dr. S. C. Bhargava for their precious suggestions to enrich the training programme.

I wish to express my deep sense of gratitude to all the members of the resource team - Prof. A. B. Saxena, Principal, RIE, Ajmer, Prof. H. C. Jain, Head, DESM, Dr. S. C. Bhargava, Reader in Chemistry, Dr. K. C. Sharma, Reader in Physics, Dr. S. K. Paradkar Reader in physics, Dr. A. K. Mohapatra, Reader in Zoology, Dr. S. V. Sharma, Lecturer in Physics and Shri V. P. Arya for their academic contribution to the programme.

It is a pleasure to recognise the skillful assistance of Shri Bishamber Dass jee, shri Hussain Ali, Shri Jagdish Verma and shri chhotu jee. and Shri Hemant Bhati.

Resource Persons

1. **Prof. A. B. Saxena, Principal, RIE, Ajmer**
2. **Prof. H. C. Jain, Head, DESM**
3. **Dr.S. C. Bhargava, Reader in Chemistry**
4. **Dr. K. C. Sharma, Reader in Physics**
5. **Dr. S. K. Paradkar, Reader in Physics**
6. **Dr. A. K. Mohapatra, Reader in Zoology**
7. **Dr. S. V. Sharma, Lecturer in Physics**
8. **Sh. V. P. Arya, Lecturer in Physics**

Dr.(Mrs.) Shashi Prabha,
Lecturer in Physics
Programme Coordinator

Conduct of the Training Programme

A five days training programme for the teachers on Methodology of teaching science with special emphasis on Physics at Secondary Level for Himachal Pradesh was conducted at RIE, Ajmer from 15th January to 19th January, 2004. In all 24 participants/KRPs attended the programme Different phases of the programme were as under:

1) Orientation of the KRPs on the various methodology of teaching Science.
2) Presentation of different topics by different techniques, strategies and tactics followed by activities and group discussion.
3) Performance of activities and practicals in physics, Chemistry and Biology.
4) Hands on experience on the use of multimedia for teaching Science.
5) Introduction to evaluation and grading.
6) Preparation of instructional modules interwoven with different methodologies of teaching science through group work of the participants.
7) Presentation by the participants on activity based teaching, project method and concept mapping.
8) Group discussion on the ways and means of implementing various methodologies in real class room situation.

CONTENTS

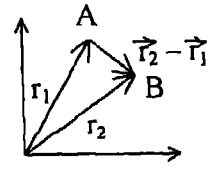
Motion and Force

A.B.Saxena

Motion

- **Motion is relative and is defined with respect to a frame.**

- **Displacement is a vector quantity** which has both magnitude and direction Displacement of a particle is equal to the change of its position vector i e – $\vec{s} = \vec{r}_2 - \vec{r}_1$



- **Two vectors are equal only if their magnitudes are equal and direction is same.**

- Displacement – time curve can be used to assess motion of a body Fig 1 shows bodies at reast, with constant velocity, increasing velocity and decreasing velocity

- Average velocity = $\frac{s_2 - s_1}{t_2 - t_1}$

A = Body at rest,
B = Constant velocity,
C = Increasing velocity,
D = Decreasing velocity

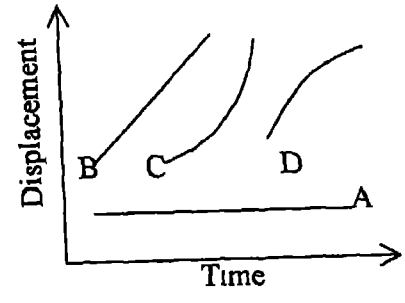
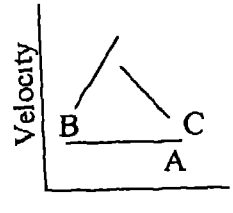


Fig 1

- **Instantaneous acceleration is equal to the slope of velocity time curve at that instant**

- Figure 2 shows velocity time curve for bodies with constant velocity, increasing and decreasing velocity with constant acceleration.

A = Constant Velocity
B = Increasing Velocity
C = Decreasing Velocity



- Area between velocity–time curve shows the distance covered by the body

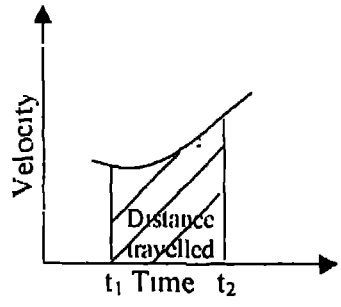


Fig 3

- Equations of motion are
  $v = u + at$ $s = ut + (½)\,at^2$ and $v^2 = u^2 + 2as$

- **Motion in a circle with constant speed is an example of continuously changing velocity therefore accelerated motion.** Acceleration in this case is always towards centre

Force

- **Force is necessary for change in velocity of a body** (either change in direction or magnitude or both)

- Newton's first law states that **velocity of a body** (state of rest or constant velocity in a given direction) **does not change unless external force is applied on the body.**

- Inertia of a body is responsible to keep the state of motion of the body unchanged in the absence of external force

- Inertia of rest is the tendency to keep the body at rest Inertia of motions is the tendency to keep the body in motion

- Moon and earth keep on moving due to inertia and gravitational force provides centripetal acceleration that changes direction of motion

- From, Newton's second law, for bodies of constant mass,
  Force (N) = Mass (kg) x Acceleration (m/s^2)

- This is very important and universal law It can be used to find acceleration of a body To do this, find the resultant force acting on the body **Acceleration of the body is in the direction of resultant force** and its magnitude is given by

  Acceleration = Resultant force / mass

- Momentum = Mass x velocity
  Momentum is a vector quantity and is in the direction of motion

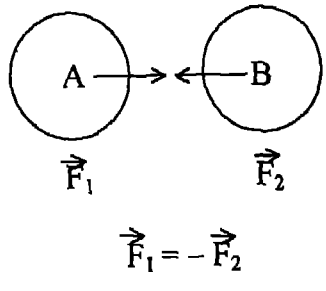
- **For an isolated system momentum is conserved** This is seen in propulsion of a rocket, backward jerk on the gun, explosion of a bomb etc Mathematically,

  Vector sum of momentum of all the bodies initially = Vector sum of momentum of all the bodies finally

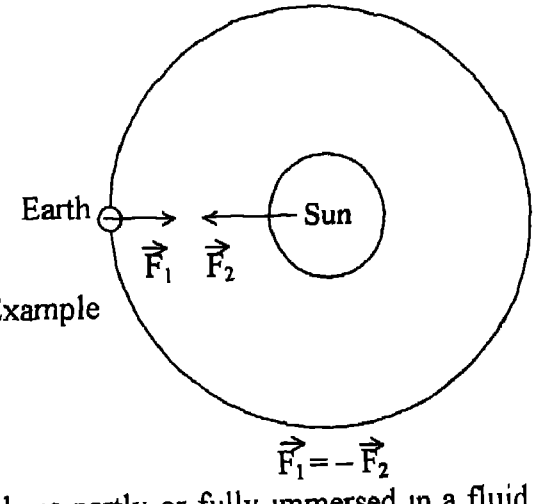
  or

$$m_1\vec{u_1} + m_2\vec{u_2} + \text{----------} = m_1\vec{v_1} + m_2\vec{v_2} + \text{----------}$$

- Newton's third law is concerned with – two bodies Force acting on body A due to body B is equal in magnitude and opposite in direction to the force acting on body B due to A



For Example



- Archemedes' principle If a body is partly or fully immersed in a fluid, an upward force (upthrust) acts on the body which is equal is magnitude to the weight of displaced fluid

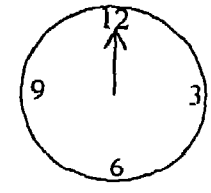
- The above mentioned law is applicable on all fluids that include gases and liquids and is applicable only when there is gravitational force

- If, (i) upthrust is greater than weight of the body, the body floats, (ii) up thrust is equal to weight of the body it just floats and (iii) upthrust is less than the weight, it sinks
- To make body float (as in case of a ship) the design of the body is made such that it displaces larger fluid so that upthrust is increased and the body floats

Problems for discussion

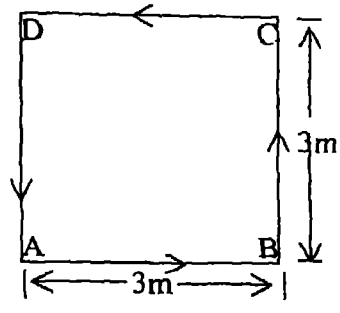
Q1 The second – hand of a wall clock is 0 10 m long and rotates at a constant rate What are the following when it is at number 12,

(a) Direction of velocity of the tip of the hand
(b) Magnitude of the velocity of the tip of the hand
(c) Magnitude and direction of the acceleration of the tip of the hand

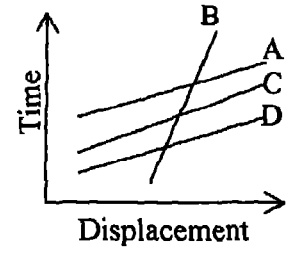


Q2 A boy walks from A to B, to C and to D and finally D to A He takes 12 s to walk for the total motion from A to back to A

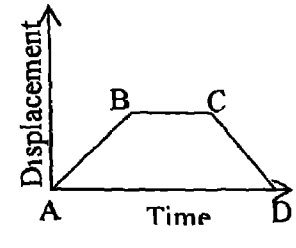
(a) What is the total displacement of the boy ?
(b) What is the average speed of the boy?
(c) What is the average velocity and its direction for motion (i) from A to C and (ii) A to D ?



Q3 Fig Shows displacement time graph for four bodies Which two bodies, if any, have equal velocity and when?



Q4 Fig Shows displacement of a body at different times When the body does have zero velocity?



Q5 A stone is attracted by the earth due to gravitational force of 20 N What is the force, if any, by which the stone attracts the earth?

Q6 A constant force applied on a body results in,

(a) Constant velocity
(b) Constant acceleration
(c) Constant momentum
(d) Constant energy

[choose the correct response]

Q7 A car moving with velocity 36 km/h strikes a tree and comes to rest in 5s If mass of the car is 1,000 kg , what is the force applied by the car on the tree?

Q8 A body of weight 1000 N is falling, It experiences an upward air resistance of 300 N If mass of the body is 100 kg , what is the acceleration of the body while falling?

Q9 The table shows position of a body at different instances Plot displacement time graph and from the graph by joining the points by a smooth curve find velocity at t=2 0s, 3 0s, 3 5s, 4 0s, 4 5s, 5 0s 6 0s positions Plot velocity time graph and use it to calculate and plot acceleration time graph

Displacement x (cm)	20	40	60	80	100	120	140
Time (s)	1 5	2 8	3 1	4 0	4 5	5 4	6 3

Teaching of Science / Physics

Focus of attention

- Structure of thought, previous ideas, historical perspectives.
- Psychological order of discipline as a contrast to logical order
- Alternative frameworks and their implications
- Opportunities to test ideas
- During curriculum transactions:

Encourage	Avoid
➢ Children participation	➢ Lecture
➢ Discussion	➢ Transmission of knowledge
➢ Verbalisation of ideas	➢ Passive learning
➢ Implications of the existing ideas	➢ Ignorance of students' existing ideas
➢ Testing of ideas / implications	

Methodology for teaching

a Adopt **Constructivist approach** of teaching This could have the following characteristics
- ➢ Maximise student participation
- ➢ Let the student state their ideas without inhibition or fear of evaluation
- ➢ Students are encouraged to discuss and debate pros and cons, implications of various ideas
- ➢ Pure lectures are reduced to minimum.
- ➢ Students are asked to think aloud, make hypothesis, test them and evaluate their ideas

b Identify learning difficulties and discuss with students, provide additional experiences

c Identify common misconceptions Design new activities, situations that confront the existing ideas

d Reasons for failing to solve problems need to be explored These could be,
- i Lack of understanding of the problem
- ii Lack of knowledge required
- iii Existence of alternative frameworks
- iv Lack of procedural knowledge

Nuclear Fission and Fusion
By concept mapping

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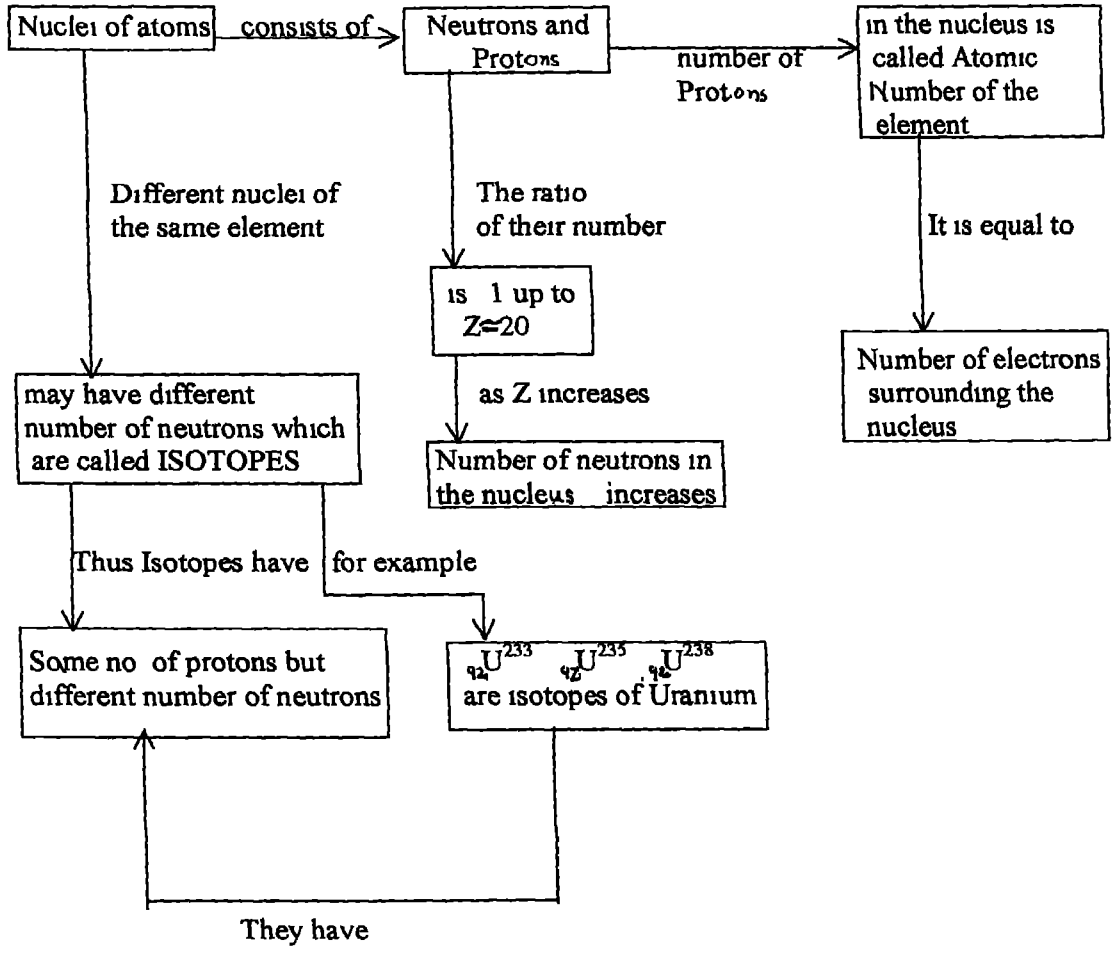
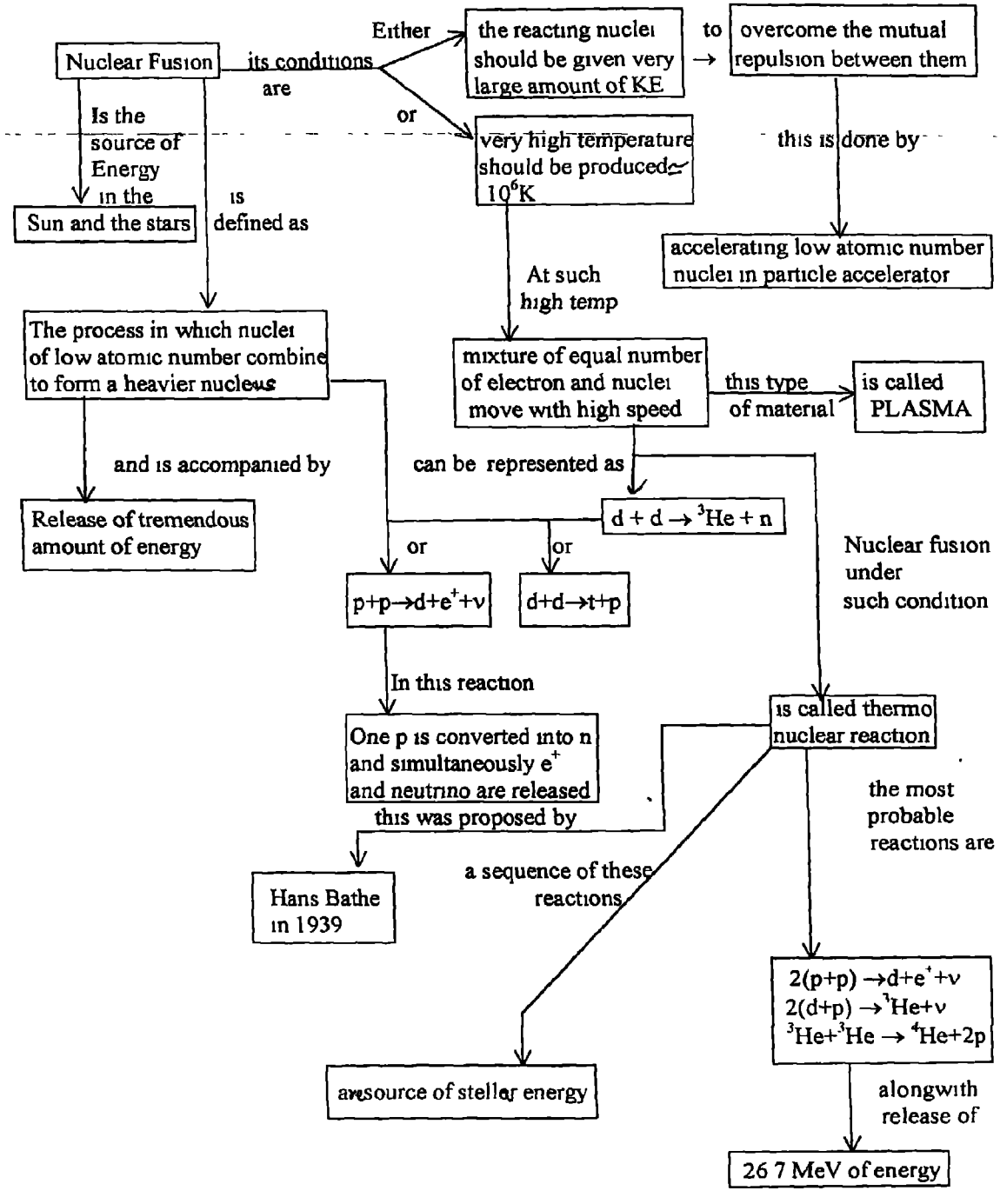
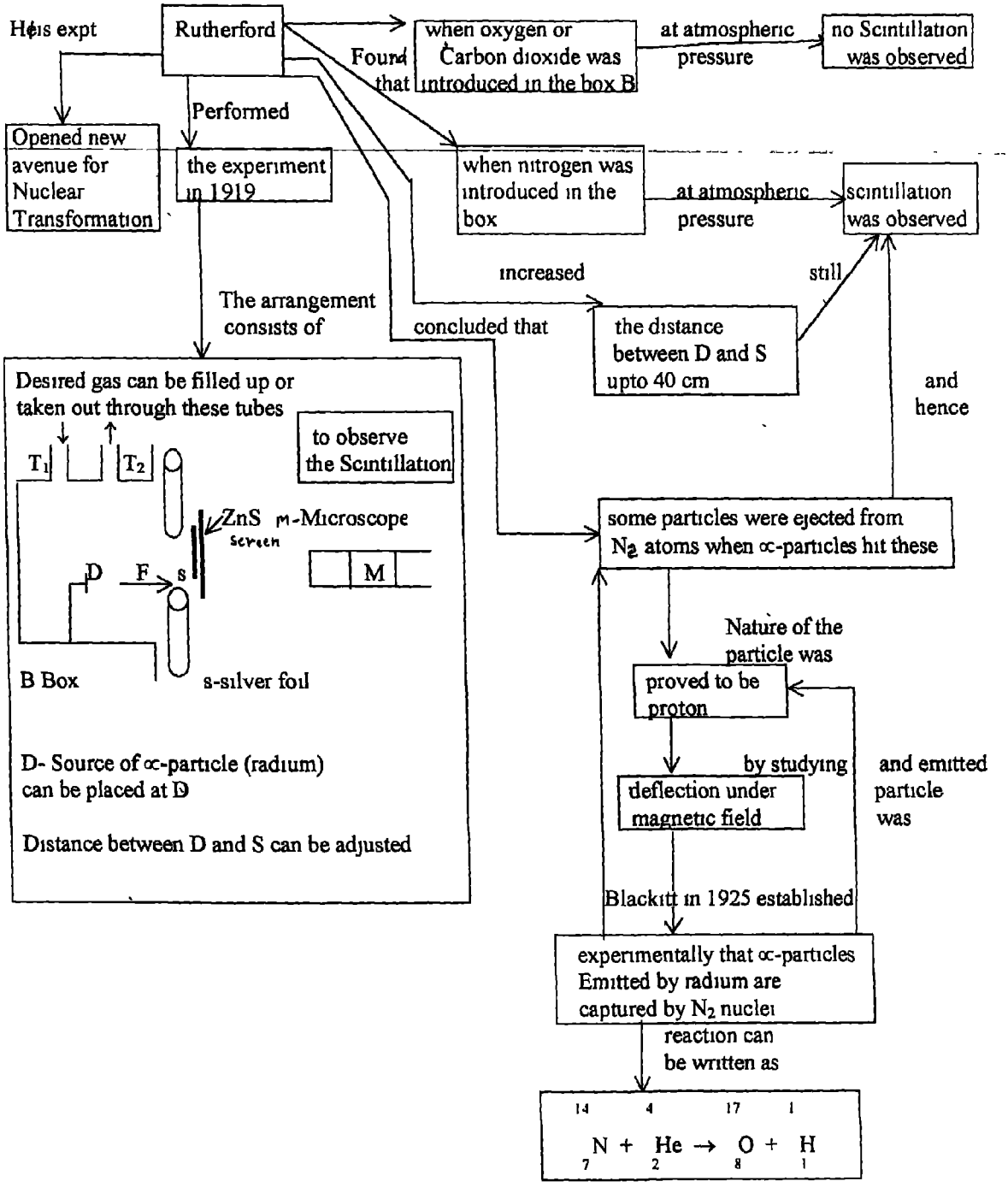
Nuclear Structure



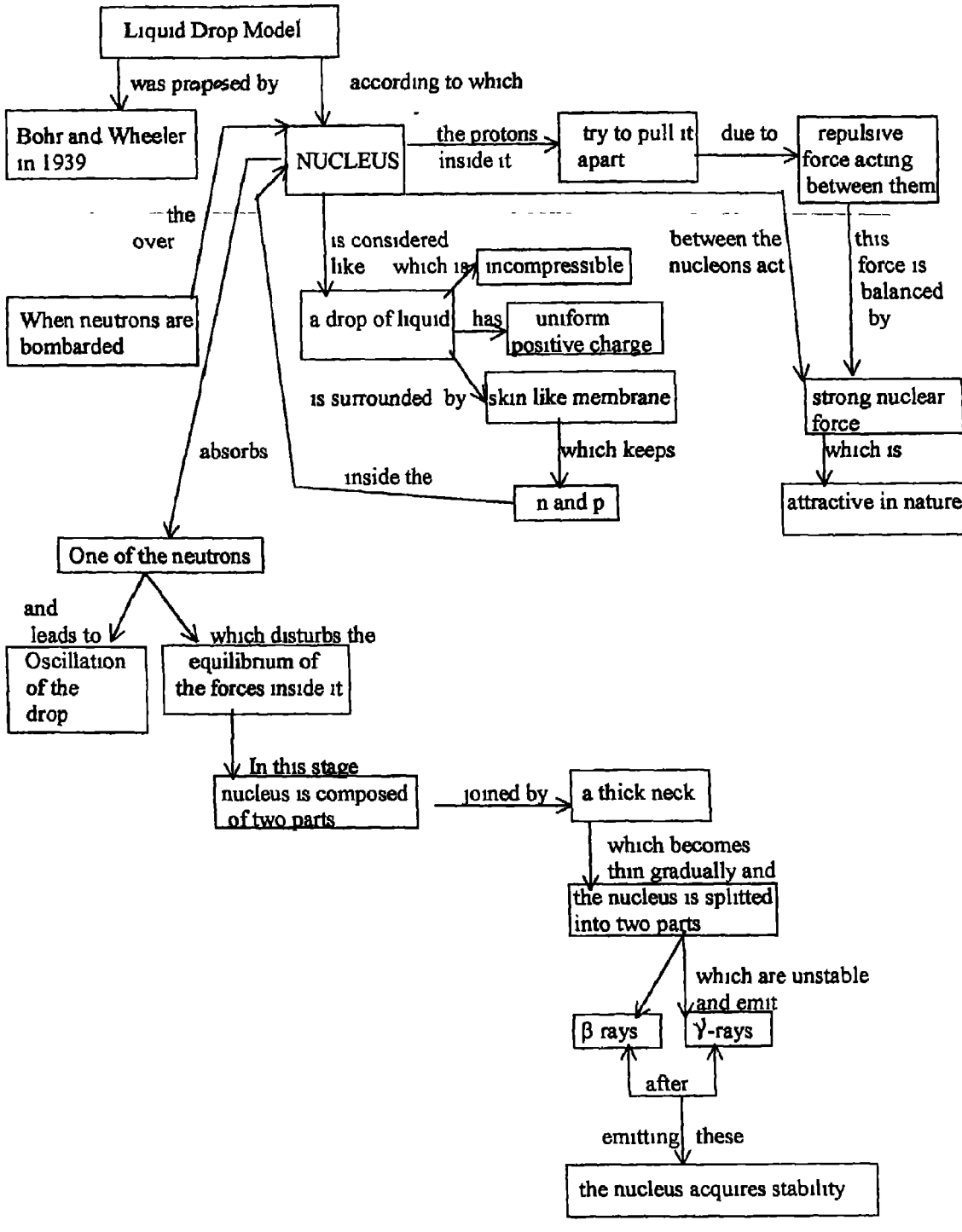
Nuclear Fusion



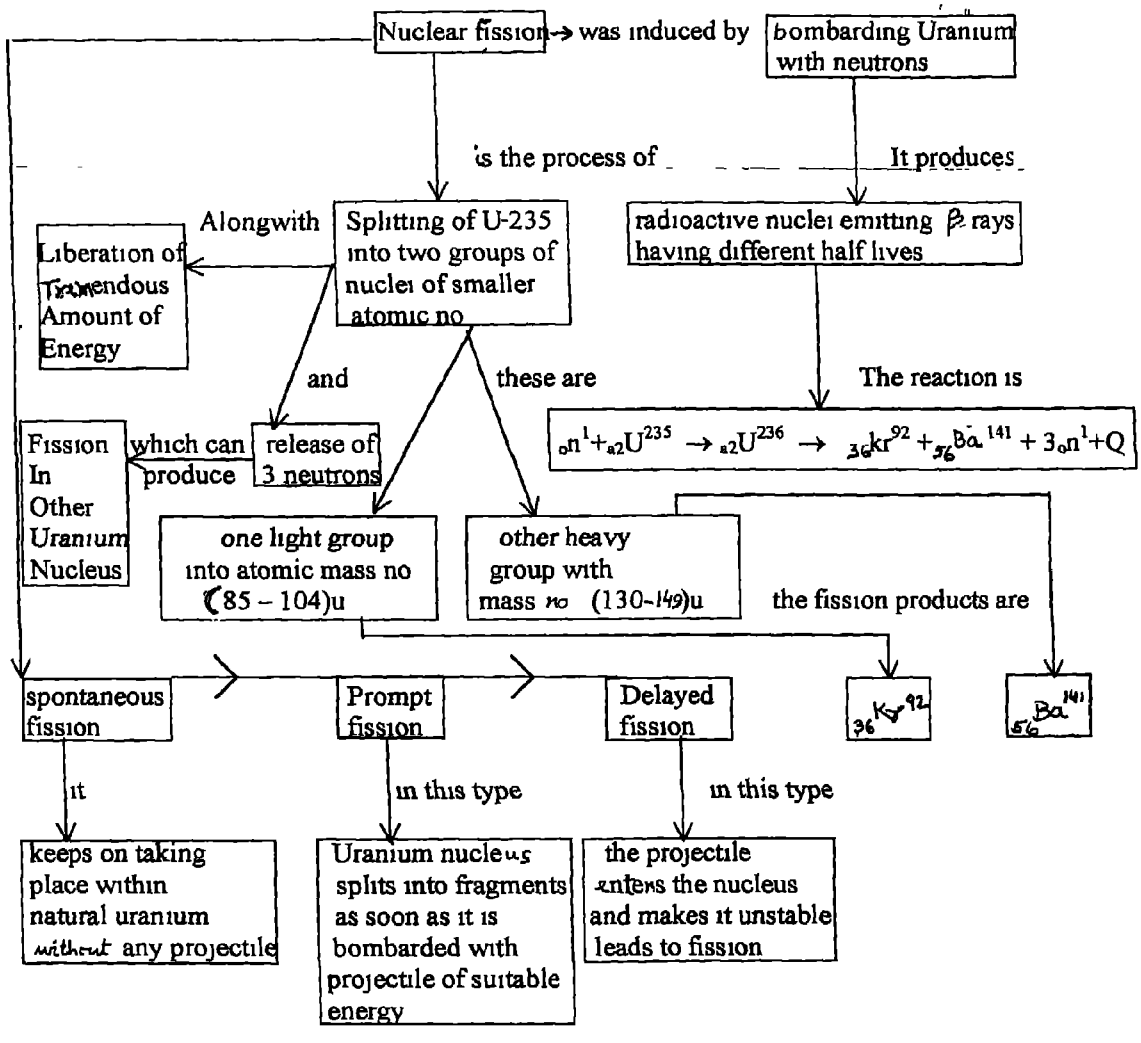
Rutherford Experiment



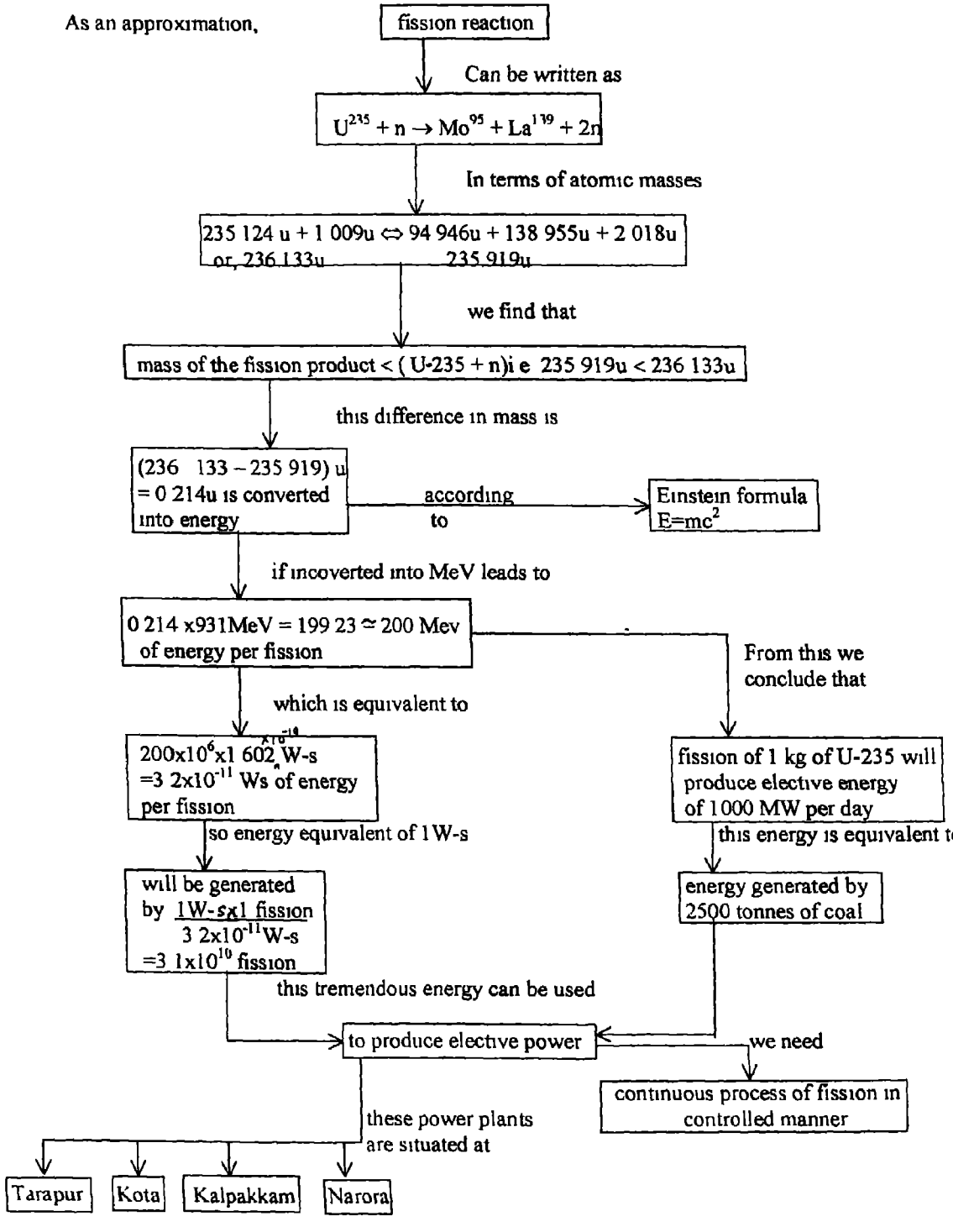
Liquid Drop Model

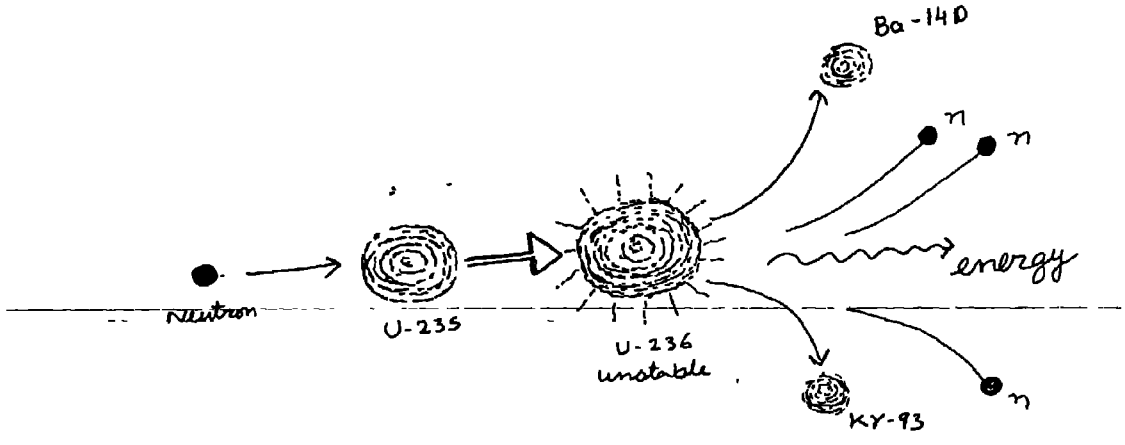


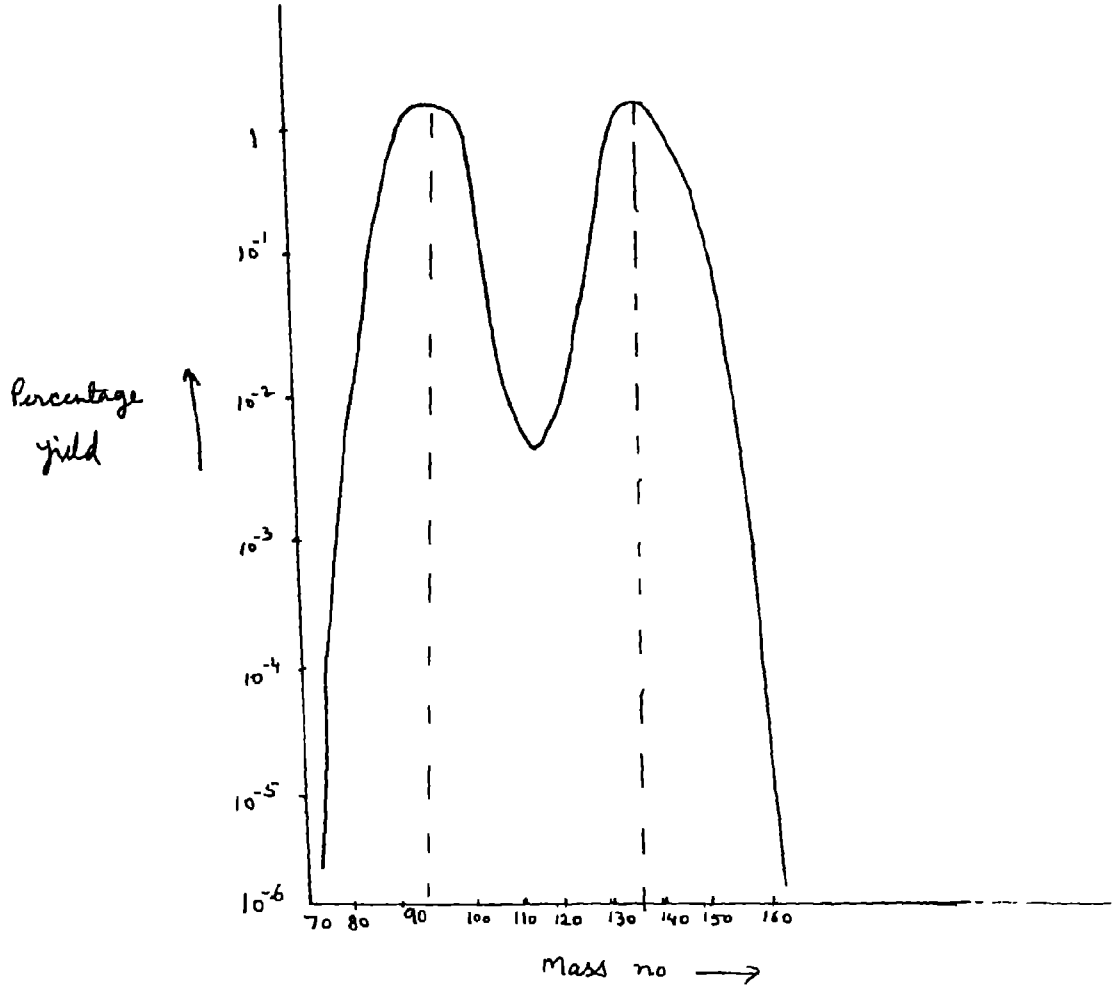
Nucleon Fission



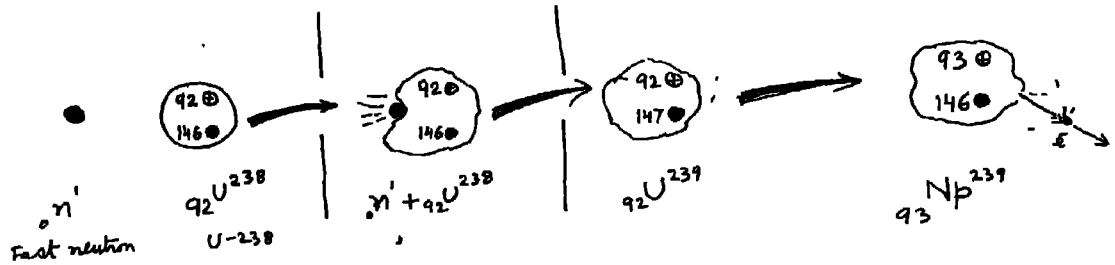
Energy Released in Fission Reaction

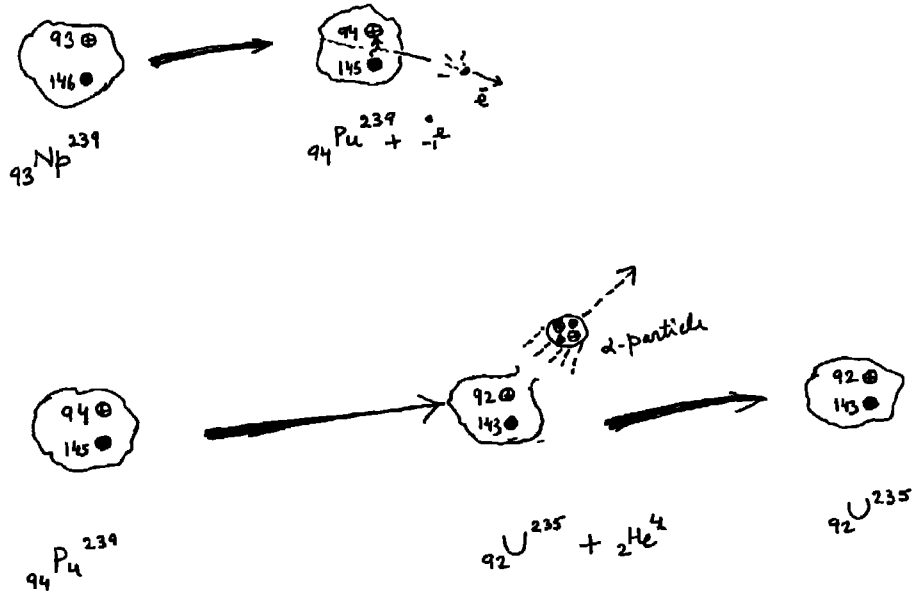






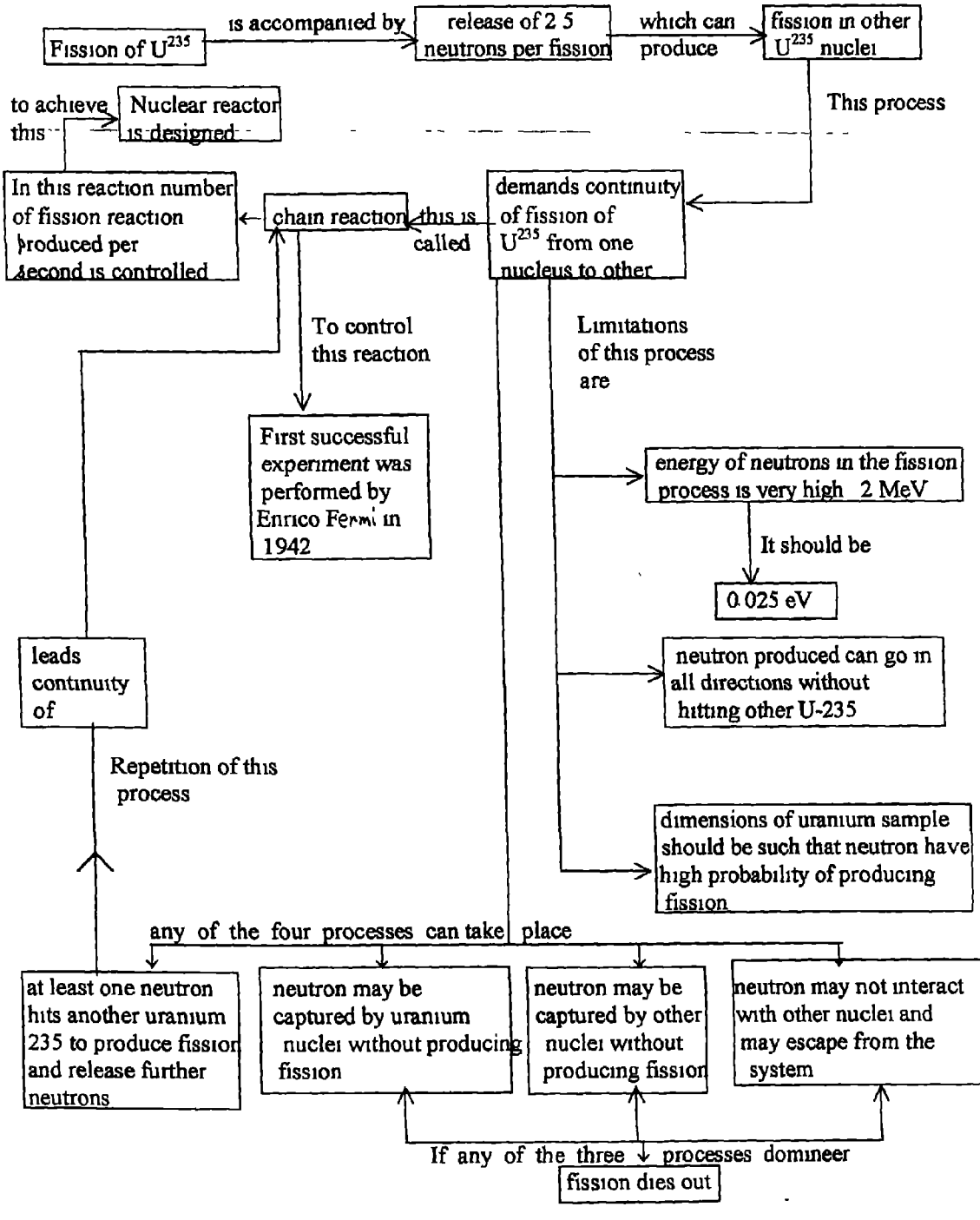
Mass distribution curve of fission products of



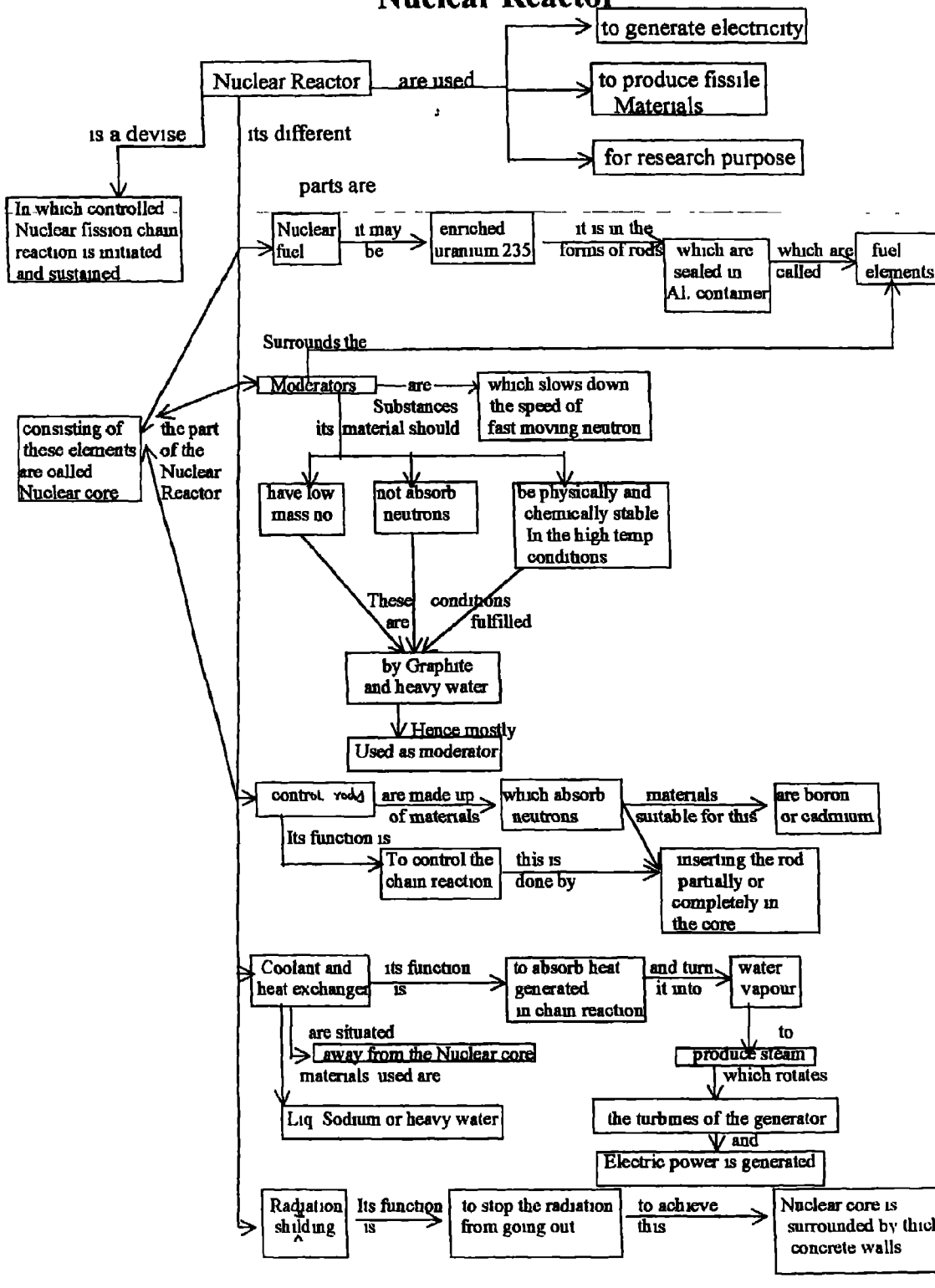


Nuclear reaction produced by fast neutron in U-238 leading to creation of plutonium Pu-239. It is unstable and decays into U-235 nucleus, by emitting an alpha-particle.

Controlled Chain reaction



Nuclear Reactor



Wave Motion and Sound

Prof. H. C. Jain

Students might have observed waves at different places These waves are characterised using different terms Motion of the waves can be different depending upon the material and medium To understand these aspects following concepts may be developed using the activities described below Also how the study of the waves and its motion has been useful in designing several instruments is given at the end

Recognize the objects/bodies executing periodic motion

Ask the students to recollect bodies/objects executing vibrations or to and fro motion You may also suggest/demonstrate such as child on a swing, motion of a pendulum, motion of strip clamped at one end etc. Discussion may be done as regards vibration of a tuning fork, vibrating string when plucked, tabla membrane when struck, brass bell when struck with a hammer etc in which cases the vibrations are not readily noticeable Extend the discussion by asking as to what is common in all the above? The concept of periodicity i.e repetition of motion at regular interval of time may then be arrived

Infer that time period of an oscillating body is independent of amplitude:

Take a pendulum and/ or a loaded spring and show the to and fro motion. Introduce the term oscillation, amplitude, displacement, frequency and time period using this activity. Ask the students to measure the time for 15 oscillations starting with different amplitude. Let the students calculate time period and frequency given the number of oscillations and infer.

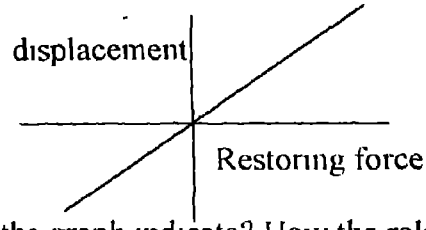
See the relationship between the displacement of a loaded spring and the force acting on it:

Let one end of a spring be fixed and suspend some weight on the other end Ask the students to note down the displacement for different weights suspended at the other end and plot a graph between the weight suspended and displacement Discuss about straight line graph with the students so as to infer.

Now let the weight be pulled down and released Introduce the term restoring force because of which the weight moves towards the equilibrium position Discuss (a) what are the directions of the applied force and restoring force? What does it indicate? (b) How much is the restoring force in the equilibrium position (c) Why does the weight overshoot the equilibrium position? (d) Why does the amplitude decrease with time?

Interpret the graph between the restoring force and displacement:

Discuss that the restoring force is due to the elastic property of the spring It is maximum at the extreme positions and zero at equilibrium position Using this discussion draw the graph between restoring force and displacement as given below.



What does the graph indicate? How the relationship between the restoring force and displacement can be written mathematically? What does the negative sign in the relationship F = -kx indicate?

Identify the characteristics of Simple Harmonic Motion S. H. M.

Help the students to recognize the following properties using the motion of the loaded spring·

(i) Restoring force is always directed towards a fixed point in the path of the motion

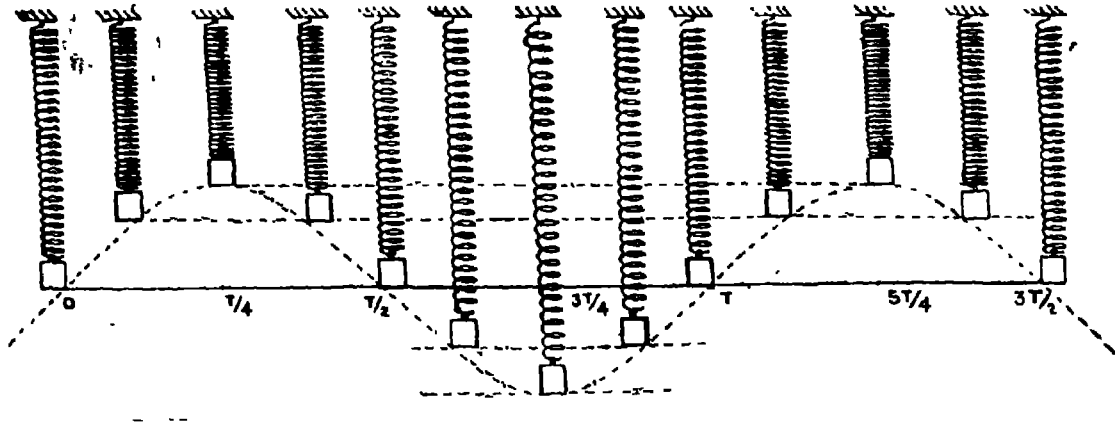
(ii) Restoring force is always proportional to displacement and oppositely directed

Discuss that any periodic motion having the above characteristics is known as simple harmonic motion (S.H M)

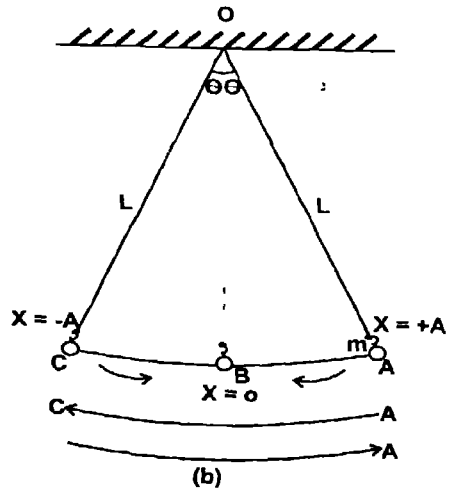
Also relate the straight line graph given above with the simple harmonic motion.

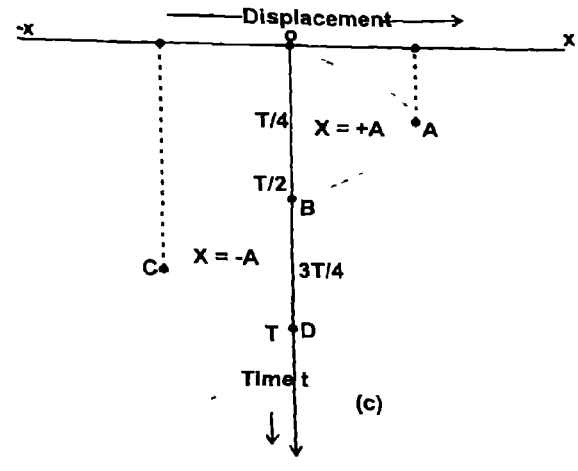
Draw the displacement time curve for the motion of a loaded spring:

Taking the equilibrium position as reference line, draw different positions of the loaded spring when in motion as given below·



Similarly draw time displacement curve given below in case of pendulum executing to and fro motion

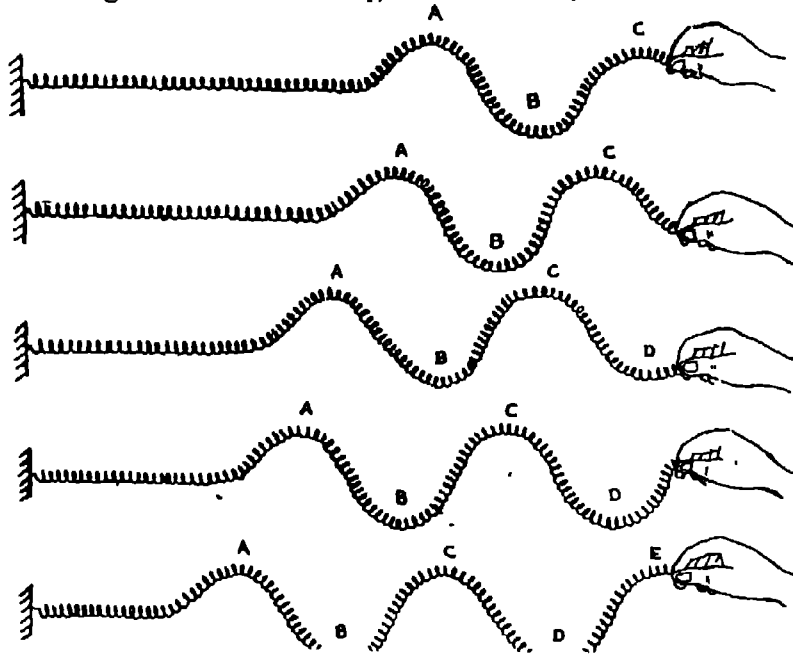




Discuss the shape of the curves obtained Introduce that the plot is a sine curve which is mathematically represented as Y = A sin ωt. Explain the symbols and the equation describing S. H M

Observe the pulse and its movement in slinky:

Stretch the slinky Give a sudden short, jerky, sideways motion to the free end. Disturbance so caused is called a pulse which moves along the spring towards the fixed end Ask the students to observe the pulse, its shape, speed and the way it moves. Help them to conclude that the shape of the pulse does not change as it moves along Besides its speed remains constant.



Infer that the speed of the pulse in a medium is independent of the shape and amplitude of the pulse:

Produce a pulse in a slinky by displacing its free end sideways in a jerky motion Ask the students to measure the time required for the pulse to reach the other end Now produce the pulse the same way but altering the duration of the sideways-jerky motion Let the students again measure the time for the pulse to reach the other end

Now produce the pulse of larger amplitude and again let the students measure the time What conclusions can be drawn with the above observations? Discuss

Infer that the speed of the pulse depends upon medium:

Take one slinky and one spring Stretch both of them to the same length. Hold one end of both of them firmly Give a jerky motion to both simultaneously at the free ends Ask the students to observe the motion of the pulse. It will be seen that they travel with different speeds. In other words speed is dependent upon medium.

Infer that the speed of the pulse depends upon tension/condition of the medium:

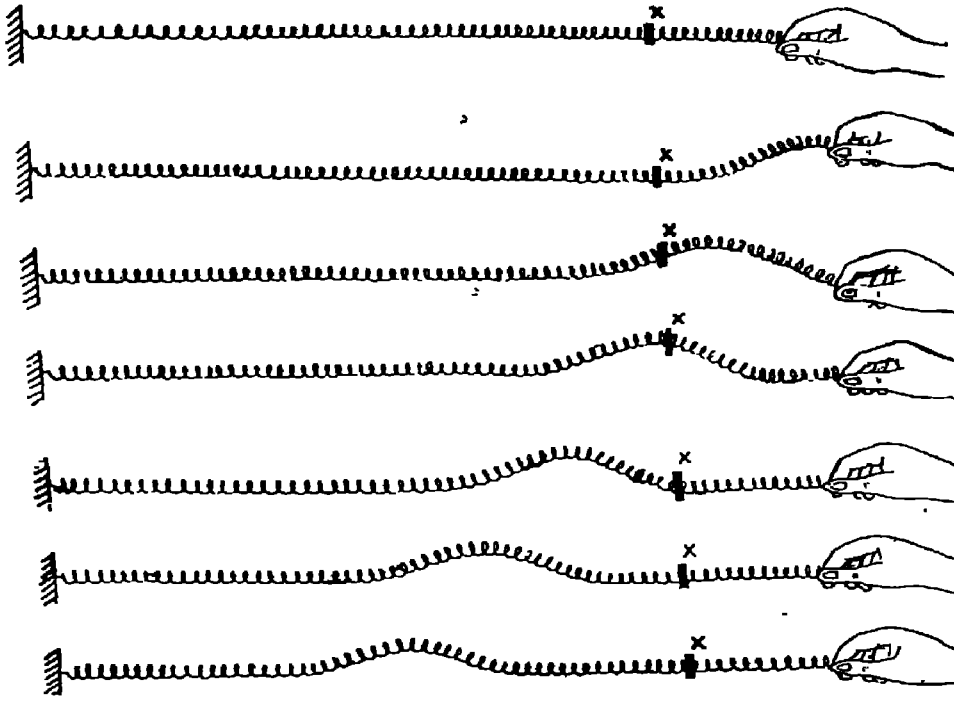
Have two slinkys of same length but different number of turns or else hold some turns of one of the slinkys if they are of same length having same number of turns. Fix one end of each of them. Generate pulse simultaneously. Ask the students to observe it will be seen that the speed is different in the two, help the students to infer that speed of the pulse is dependent on tension

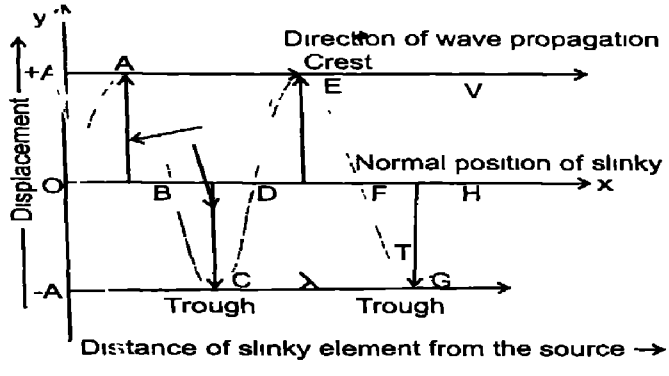
Observe transverse and longitudinal waves in a spring:

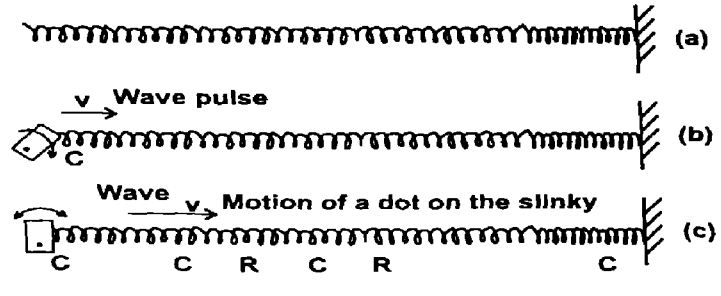
(a) Have a slinky and hold its one end. Produce a series of pulses by moving the free end in rapid succession sideways Train of pulses constitutes progressive waves

Tie a loop of thread at some point along the slinky Perform the above activity and ask the students to note down the movement at that particular point It will be seen that it vibrates up and down as the waves moves forward Discuss that such waves are known as transverse waves

It will also be seen that the displacement gradually changes from section to section. Call the points having maximum upward displacement as crests and those having maximum downward displacement as trough




y
Direction of wave propagation
Crest
+A
A
E
V
Displacement
Normal position of slinky
O
x
B
D
F
H
T
C
G
-A
Trough
Trough
Distance of slinky element from the source →


(a)
v
Wave pulse
C
(b)
Wave
v
Motion of a dot on the slinky
(c)
C
C
R
C
R
C

(b) Stretch the slinky and hold one end firmly keeping the slinky in the horizontal position, give a jerk to the free end Or else hold 8 to 10 turns of the slinky and release the same suddenly What type of disturbance is observed? Ask the students. It will be seen that the compression travels along the slinky as the pulse Now mark a dot on the slinky and apply push and pull periodically on the free end of the slinky. Ask the students to observe the dot It will be seen that dot moves back and forth, as the wave moves Call such waves as longitudinal waves. Also the regions where the coils become closer, call them as compressions and where these become further apart, as rarefactions

Recognize that sound is produced because of vibrations in solid bodies/objects and air:

Ask the students to think how sound is produced when a bell is struck with a hammer, air is blown in a toy whistle, a horn is blown, blades of the fan start rotating, leaves rustle, we speak or sing, steam comes out nozzle in a pressure cooker and so on Discussion should lead to the conclusion that vibrations take place in the objects, in air etc though in some cases these are not visible but can be felt by touching such as bell, vocal cord, diaphragm of the loud speaker of transistor/T V. etc.

Infer that a vibrating body alternately compresses the adjacent layer or conversely produces rarefaction in the layer.

Students are aware that a spring can be compressed or elongated Air also behaves like a spring. To arrive at this concept take a pichkari Close the nozzle with one finger and press the piston a little and leave What is observed? Explain As a second case, pull out the piston slightly and leave Again observe and explain With this analogy, explain that the propagation of sound in air consists of a series of compressions and rarefactions through the air Discussion may be expanded further by mentioning that compression and rarefaction taking place in air because of vibration of a tuning fork etc. are similar to to and fro motion of a pendulum.

Identify that the requirements for sensation of sound are the source (vibrating body), elastic medium for propagation and the vibrations in the ear:

It is obvious that a source is required to produce vibrations in a body To show that a medium is required for propagation of vibration can be done with the activity given below

Take a flask Fill some water, Suspend some jingle bells Close the flask with a rubber cork Shake the flask. Observe the intensity of the ringing bells. Remove the stopper Boil water for some time Close the flask with the

stopper and let the flask cool down Shake the flask Why the intensity of sound of the ringing bells decrease now? Ask the students to imagine if there was no air in the flask, what would happen to sound from the ringing bells?

Now explain to the students that when compressions and rarefactions in air lead to sound propagation, these disturbances on reaching the ear, make the ear drum vibrate in a similar way Consequently the brain interprets the sound through auditory nerves

Recall the different sound on the basis of frequency & intensity:

Audible range	20 Hz – 20,000 Hz
Infrasonic	Less than 20 Hz
Ultrasonic	Greater than 20, 000 Hz
Supersonic	Having speed greater than that of sound

Description of Loudness	Intensity Levels	Places of origin of sounds
Very Loud	130	Threshold of feeling Limit of ear endurance.
	120	Roar of aeroplane engine & propeller
	110	Violent hammering of steel plate
	100	Nearing express train.
Loud	90	Loud Motor horn, Brass band using wind Pipes
	80	Loud radio music, Average motor horn
	70	Inside tram, train with windows open
Moderate	60	Busy street traffic, Loud conversation.
	50	Inside train (windows closed)
	40	Inside good car with moderate speed.
Quiet	30	Suburban street in quiet evening
	20	Faint whisper, Quiet in garden
	10	Faintest audible sound.
Silence	0	Threshold of audibility

Logarithm of the ratio of intensity of any sound to the just audible sound to the base 10 is called sound of 1 Bell intensity or 10 decibel (db).

Recall the applications of reflection of sound:

Knowledge of reflection of sound has helped in designing instruments, which are of use to human beings

Shape of loudspeaker and megaphone is so made that it prevents sound waves from spreading in unwanted directions Hearing aid are so designed that it enhances the amplitude of the vibrating layer of air in the ear. Shape of sound boards helps in spreading sound waves evenly in an auditorium Knowledge of echo helps in identifying the distance of the objects Most significant application is in **SONAR**, which is used to detect underwater objects viz submarine, sea rocks, sunken ship, hidden iceberg Also ocean depth an be determined Ultrasonic waves are similarly used for medical diagnosis and therapy and as a surgical heartbeat of foetus and pulsation of arterial walls. Eye tumors can even be located using ultrasonography Another significant application of the knowledge of sound characteristics such as pitch, intensity, waveform and others help in designing of various musical instruments. Also knowledge about echo helps in building auditorium and other structures

GRAVITATION

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A truly universal phenomenon of attraction between material bodies at all levels, from smallest to largest from lightest to heaviest, nearest to farthest It is all pervading and perhaps came along in existence with the beginning of universe It is also responsible for the formation of stars, pulsar, black holes etc and also for many other phenomena around us on earth It is also the most studies phenomenon from early times Existence of life owes much to gravitation Think what could possibly happen if the gravitation suddenly disappears

1. The Force Law

Newton formulated the universal law of gravitational force as this Force is (i) proportional to m_1 m_2 and (ii) inversely proportional to r^2 it is therèfore given by

$$F = \frac{G m_1 m_2}{r^2} \qquad \text{----------(1)}$$

G is the constant of proportionality and is known as the universal constant of Gravitation The value of $G = 6.67 \times 10^{-11}\ Nm^2/Kg^2$

It was first determined by Henry Cavendish in 1736 (about 70 years after the law was formulated by Newton)

2. Gravitational Potential Energy

The gravitational potential energy of a two particle system separated by a distance r is given as

$$U = -\frac{G m_1 m_2}{r} \qquad \text{----------(2)}$$

(the zero of potential energy corresponds to $r = \infty$)

It is actually equal to the work done by various forces in assembling the system from infinity

3. Gravitation potential

The gravitational potential at a point is equal to the potential energy per unit mass as the mass is brought from infinity to the given point

$$V = \frac{U}{m} \qquad \text{----------(3)}$$

The difference in gravitational potential energy between two points A and B

$$V_B - V_a = \frac{U_B - U_A}{m}$$

The gravitational potential on the earth at any distance r is equal to

$$-\frac{GMe}{r} \qquad \text{--------(4)}$$

Where Me is the mass of the earth and r is the distance from centre of mass i e centre of earth

4. The Gravitational Field

From an action at a distance point of view it is assumed that a body A creates a gravitational field in the space around it (just like an electrical charge or a magnet creates) This field has its own existence, stores energy and can impart momentum and has a definite direction at each point. When another body B is placed in the gravitational field of A this field exerts a force on B or the two fields of bodies A and B interact with mutual exchange of field energy and momentum The potential energy of the system also change in the process However to simplify the matter it is assumes that when the other body B is placed in the gravitational field of A, the field exerts a force on it The direction and the intensity of the field is defined in relation to the force it exerts on a body placed in it The intensity of gravitational field E at a point

$$E = F/m \quad (N/kg) \qquad \text{----------(5)}$$

(iii) At poles and equator

(iv) Non uniformity of composition of Earth – local effects

(v) Rotation of earth ($F_{(mg)}' = mg - m\omega^2 r$ or $g' = g - \omega^2 r$)

6. Planets and Satellites

Planets revolve around the sun (mass M) due to force of Gravity

Let the radius of the orbit be a

The Gravitational force on the planet of mass m provides centripetal acceleration

Given by

$GMm / a^2 = m V^2/a$

Speed $V = (GM/a)^{1/2}$ ----------(8)

Time period $T = \frac{2\Pi a}{V} = \frac{2\Pi a}{\sqrt{GM/a}} = \frac{2\Pi a^{3/2}}{\sqrt{Gm}}$

$T^2 = \frac{4\Pi^2}{GM} a^3$ --------- (9)

Kinetic Energy $= K = \frac{1}{2} mv^2 = \frac{1}{2} m\, GM/a = GMm/2a$

Potential Energy $U = - GMm/a$, the total energy $E = K + U = GMm/2a - GMm/a$

$= - GMm/2a$

7. Earth's Satellite

Above treatment applies for earth's satellites also Geostationary satellites have T= 24 hours

8. Escape velocity

$\frac{1}{2} mv^2 \geq GMm/r$

$v \geq \sqrt{2GM/r}$ = 11 6 km/s on earth

9. Centre of mass and centre of gravity

10. Motion of particles under gravity

$v = u + gt$ $s = ut + 1/2\ g t^2$ $v^2 = u^2 + 2gs$ motion of a practice

The gravitational field add according to the rules of vector addition

On earth this gravitational field :

$E = F/m = mg/m = g$ is called the acceleration due to gravity Though the two things E and g on earth are equal in magnitude and direction but they are two different physical entities

Relation between gravitational field and potential can be obtained in the following way

Since $\vec{F} = \vec{mE}$ and work done $\Delta W = F\ \Delta r$

$\Delta U = -\Delta W = -mE\ \Delta r$

$\Delta V = \Delta U/m = -E\ \Delta r$

$E = -\Delta V/\Delta r$ ---------- (6)

5. Acceleration due to gravity on earth "g".

The force of gravitation on a body of mass m on earth

$$F = \frac{GMm}{r^2}$$ [r is the distance from the centre of earth]

This force causes an acceleration m a

$m\,a = GM_em / r^2$

This acceleration is indicated by "g"

$g = Gm_e / r^2$ ---------- (7)

The value of this acceleration due to gravity on earth ($g = 9\ 81\ m/s^2$)

Variation in the value of g

$g = GMe / r^2$

(i)	Height above the surface of earth	Decreases with height as well as depth
(ii)	Depth below the surface of earth	

11. Inertial and Gravitational Mass

Lets apply a given force F on two masses m_A and m_B

$F = m_A a_A$

And $F = m_B a_B$

$$\frac{m_A}{m_B} = \frac{a_B}{a_A} \quad \text{or } m_A = \frac{a_B}{a_A} m_B$$

This equation may be used to define the mass of an object This gives inertial mass

Another way of comparing masses of two objects may be based on the law of gravitation

$F_A = Gm_AM/r^2$

$$F_B = \frac{Gm_BM}{r^2}$$

$m_A / m_B = F_A/F_B$ or $m_A = (F_A/F_B)\, m_B$

(Gravitational and inertial masses are equal)

(Spring balance ←→ Gravitational mass)

(Weight ←→ a force = mg)

12. Mass and Weight

Mass → amount of matter defined in relation to inertial or gravitational acceleration and expressed in terms of a well defined standard mass of a kilogram.

Weight → is the force which acts on a given mass due to force of attraction due to gravity (different for different planets and places etc.)

Mass does not vary from place to place but weight does

Geotropism

In seeds and plants, whatever be the orientation, the roots always grow down ward and the shoots and the tree grow upward

Work; Energy and Power

(1) **Force** → action, kinds of forces, unit, dimension – a vector

(2) **Displacement** – a vector

(3) Force displacement coupling (togetherness→ Work)

(4) **Work** - Unit, dimension, causes change in state of motion, energy (KE)/(PE)

(5) **Energy** - K & P only - sources differ

(6) **Work Energy equivalence**

(7) **Power** - It matters to work slow, fast and faster

Work, Energy and power

Work, energy and power are perhaps the most talked about terms in Physics and in life also Force, displacement and time are intimately related with these quantities

1. Force

You have to apply some force to accomplice any action This action lasts for some duration and in some region of space

Force is commonly know as "push or pull" applied to bring a change in the state of motion (or rest) of any object

There are only four types of forces in nature (1) Gravitational, (2) Electromagnetic (3) Nuclear (strong) and (4) weak forces - which participate in physical phenomena These forces are dealt with at a later stage of learning , muscular or mechanical force are the public terms for force applied by man or any mechanical device Application of force causes acceleration, it also changes momentum and energy of a body

Force is measured in unit of "Newton" One Newton of force causes acceleration of meter per sec per sec in a body of 1 kg mass

2. Force and displacement (Scalar coupling)

As we know work is done when force is applied on any object and it shifts through a distance

Force is a vector quantity and so in the displacement. Two vector quantities can couple in two possible ways One is given by scalar product and the other is given by vector product. It is the scalar product ($F S = F S \cos\vartheta$) which gives the work done by the force (ϑ in the angle between applied force and the direction of motion of the body)

$$W = F \cdot S = F S \cos\vartheta \text{ ------- (1)}$$

That is force times the displacement in the direction of force. It is measured in the unit of Joule (1 joule = 1 Newton x 1 Meter)

3. Work and Energy

Work done on a body/system under the action of a force provide it kinetic or potential energy (as the case be) or both Energy exists in two forms only One is kinetic and the other is potential Depending on the source (either derived from or stored in), energy is referred to as solar energy, thermal energy, nuclear energy, chemical energy, gravitational energy in common parlence Work done on a system or a body causes change in its kinetic energy, potential energy, internal energy, heat contents, speed, momentum etc

But there is one strict limitation that this energy change can not exceed the amount of work done or vice versa There is perfect equivalence between work done and energy changes that takes place in the system **(Work Energy Equivalence)**

4. It matters to work slow, fast and faster

- Compare the experience when you walk slowly and when you run fast for the same distance You may feel tired after running but can walk over the same distance easily
- When you walk up a steep road, its difficult to travel straight up but convenient to travel off vertical from left to right and right to left sides of the road
- A child or an old man does work slowly while young person can do the same thing fast
- A low power machine can do work slowly while a high power machine does the same work at high speeds

In all these situations the rate of accomplishing a certain task is different may be the total work (and therefore energy by work energy equivalence) is same It therefore matters to do work slow, fast and faster

The rate of doing work or supplying energy is called "power' So power is equal to work done (or energy supplied) divided by time taken

(power) $P = w/t$) (work) / (time)

power is expressed in unit of watt 1 watt = 1 joule/ sec

Our Environment

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Overview

Environment means surroundings. Our environment provides us food to eat, air to breathe, water to drink, light for vision and suitable temperature to live The physical components of environment are soil, water, air, light and temperature. These are termed as **abiotic components**. Living things in the environment such as plants and animals including human beings are collectively referred to as **biotic component**. Living organisms do not live in isolation. They interact with one another and also interact with the non-living surroundings in which they live. The environment together with the existing living organisms in it constitute **Biosphere.**

Objectives

After studying this unit, teachers will be able to

i) identify the living and nonliving things in their surroundings;

ii) differentiate between the living and nonliving things;

iii) identify their social environment and list the components of social environment,

iv) define habitat and different types of habitat of organisms;

v) define adaptation and significance of adaptation;

vi) know various adaptive features of organisms for different modes of life;

vii) recognize and explain the interdependence of living, nonliving and social environment,

viii) define and identify the components of an ecosystem;

ix) develop an ecosystem as a project;

x) describe the elements of a food chain and a food web;

xi) illustrate some food chains and food webs from their surroundings,

xii) understand the concept of biosphere,

xiii) understand the importance of sunlight and temperature for sustenance of life,

xiv) describe how the various sources of energy on earth can be traced back to solar energy;

xv) trace the cycle of essential elements from their reservoir through the food chains and food webs and back,

xvi) illustrate the natural cycles such as water cycle, carbon cycle, nitrogen cycle and oxygen cycle;

xvii) understand how man's activities have disrupted the different biogeochemical cycles,

xviii) understand the ethical and scientific reasons for protecting the environment,

xix) develop values and attitudes required to live in harmony with the environment and

xx) relate technology, society and environmental issues.

Concepts and Transactional Strategies

At primary level, children were provided with experiences to help their socio-emotional and cultural development with a realistic awareness and perception of the phenomena occurring in the environment. They can also recognize plants and animals in their surroundings. Ensuring participation of all children in the activities, which will help in elaborating the concept of environment further, will further strengthen the experiences gained earlier. Variety of charts, models and fun games can be used for teaching this unit. Discussions, project work, and films can help students to understand the concept better. Students must be provided with problem solving situations related to their social context. The following concepts related with environment have been discussed

- Physical environment
- Living environment

- Social environment
- Physical, living and social environment interact with each other
- Habitat
- Adaptation
- Biosphere
- Ecosystem
- Food chain, food webs
- Biodiversity
- Conservation of biodiversity
- Biogeochemical cycles – Carbon cycle, Oxygen cycle, Nitrogen cycle and water cycle
- Air Pollution
- Water pollution
- Land pollution
- Soil erosion.

A. Physical, living and social environment

To enable your student to understand this subunit, you must help them to understand the concepts (1 to 5)

Concept 1. There are numerous living things in our surroundings which constitute our living environment.

Transactional Strategy

Students can be helped to develop this concept by doing activities such as

Activity 1

Students may be asked to prepare a list of living of things around them and also to indicate where these are found in a tabular form

Living things	Found in
Banana tree	Soil
Grains	Soil
Lotus	Water
Earth-worm	Soil
Ants	Soil
Termites	Wood
Fish	Water
Frog	Land, Water
Snake	Soil
Lizards	Trees
Birds	Trees
Dog	Land
Algae	Water
Snail	Water, Land

Each student will have a different list. Students should be encouraged to compare and discuss their responses.

Activity 2

Students may be asked to observe various animals and record various facts about them, such as how they move, whether they move during day time or night time, what they eat etc in a tabular form.

Animals	Moves with the help of	Moves during	Eat
Owl	Wings	Night	Fruits
Parrot	Wings	Day	Fruits
Earthworm	Body wall	Night	Soil
Frog	Limbs	Day	Insects
Cat	Legs	Day, Night	Milk, Fish
Fish	Fins	Day	Plankton
Bat	Wings	Night	Fruits

On the basis of their record of observations the students may be helped to conclude that all animals move around, eat, grow and reproduce

Concept 2. There are numerous nonliving things in our surroundings, which constitute our physical environment.

Transactional Strategy.

Students can be helped to understand the concept of physical environment with the help of following activity

Activity 3

Students may be asked to prepare a list of nonliving things in their surroundings and also to indicate which of these are natural and which are man made and whether they grow by themselves in the following manner.

Non-living things	Natural/Man made	Grows
Table		
Water		
Air		
Stone		
Books		

On the basis of their observation, students should be able to differentiate living from non-living environment.

Concept 3. Materials such as paper, cotton and wood, which can be decomposed by bacteria/living organisms, are called biodegradable whereas synthetic materials such as plastics are non-biodegradable.

Transactional Strategy

Students may be asked to list materials/objects, which they use in every day life. Student's responses may include: paper, plastic scale, wooden scale, cotton, polythene bag, shoes etc.

Which of these materials get spoiled by bacteria with time? To answer this question, students can do the following activity.

Activity 4

Dig up soil 10 to 15 cm deep at few spots in your school garden to make pits Now place the articles listed above one in each pit. Cover with soil After two to three months again dig the soil and take out these materials Students will observe that wood, cotton, paper and leather have

been decomposed by bacteria/micro-organisms where as plastic bottles and polythene bags are not decomposed

On the basis of their observations, students may be helped to infer that some materials are biodegradable whereas synthetic materials such as plastics and polythene bags are non-biodegradable These non-biodegradable plastics and polythenes cause serious environmental hazards Sometimes they block water pipes and choke sewerage system Students may be encouraged to use paper/cotton bags in place of polythene bags

Concept 4. We live in a society that has structure and dynamics and this constitutes our social environment.

Transactional Strategy

The concept of 'social environment can be explained by taking school, family, village, city etc. you can ask students to describe their school environment. They may describe school environment in terms of friends, teachers, trees, playground, studies, exams and discipline. In school, students acquire knowledge, make friends, play, learn to respect teachers, become disciplined, acquire values of punctuality etc.

That means school influences students' life in many ways. You can ask students to compare the rural and urban environment. Students may describe the influence of urbanization and industrialization on their lives Social institutions and systems have provided us policies, rules, network and other facilities for better living. For example, you observe rules while crossing a road. There are rules to check vehicular pollution. The people, the social system, its institutions and dynamics all constitute our social environment.

Concept 5. Physical, living and social environment interact and are interdependent on each other.

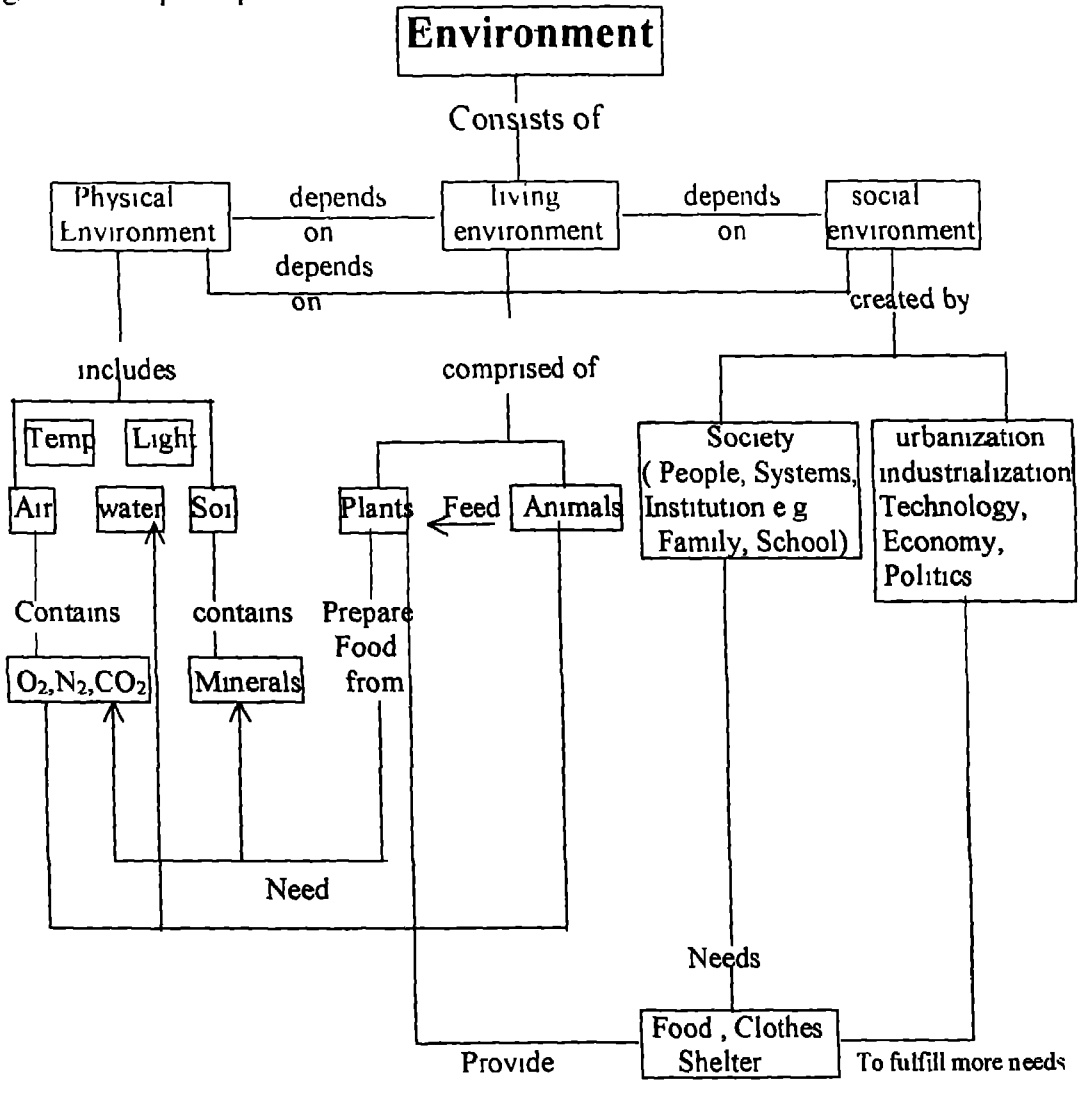
Transactional Strategy

You can help your students to understand this concept using a concept map Students may work out many more linkages, which would enable them to understand the concept

Activity 5

Draw a concept map on the black board with the help of student's responses Write the most general concept at the top followed by sub- concepts Then

draw vertical and horizontal linkages between different concepts You may get a concept map as shown below



[Concept Map – Environment and its components]

B. Habitat and Adaptation

Concept 6: The habitat of an organism is the place where it lives and grows

Transactional Strategy

Students can be helped to develop this concept by doing activities such as

Activity 6

Students may be asked to visit local habitat like school garden, pond etc and prepare a list of all plants and animals observed Record the observations as follows

a) Observe all plants found in water/Land

b) Observe all animals found in water/Land.

c) Observe basic differences between aquatic and terrestrial organisms

Activity 7

Students may be asked to observe the local habitat of their neighborhood and prepare a list of all organisms that are seen Record the observations in a tabular form mentioned below.

Organisms seen	**Habitat Aquatic/terrestrial/aerial/ Arboreal/amphibious**	**Plants/animal**
Butterfly		
Parrot		
Lotus		
Owl		
Monkeys		
Camels		
Jasmine		

On the basis of their observations, students should be able to conclude that different organisms grow in different habitat.

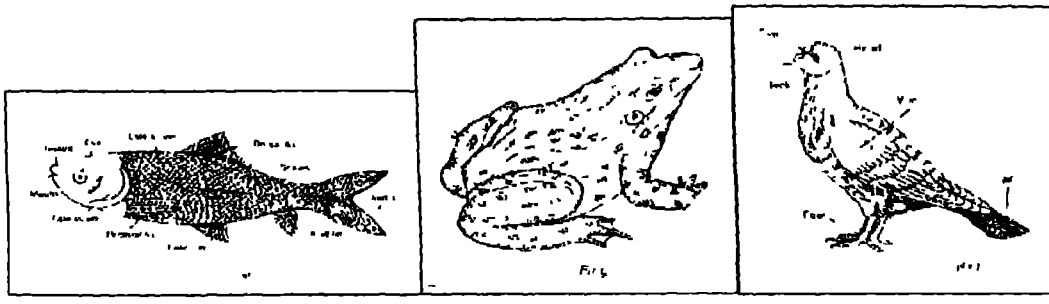
Concept 7: Various structural and functional adaptive features enable organisms to survive successfully in their respective habitat.

Transactional Strategy

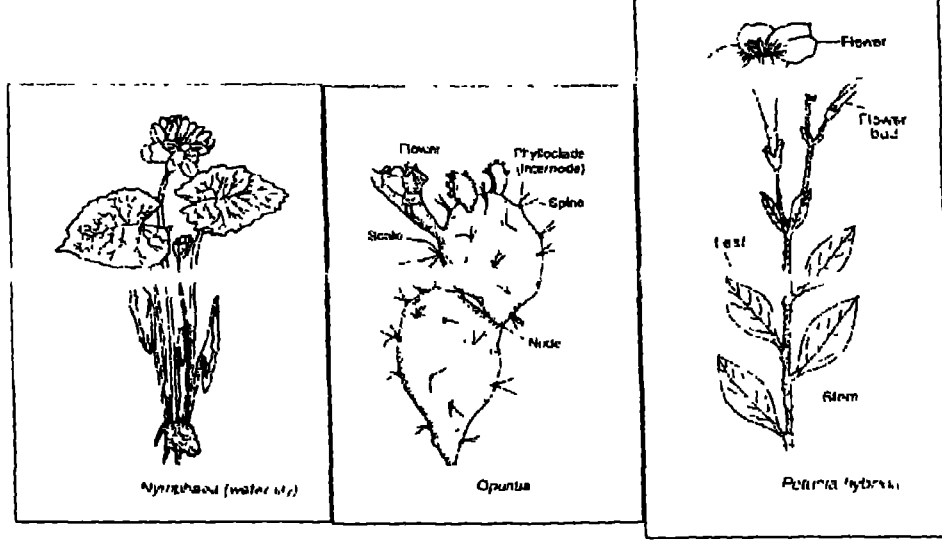
The students can be helped to understand the concept of adaptation by taking illustrations from their surroundings.

Activity 8

Students may be asked to compare external features in the organisms of different habitat and note down various modifications shown by them.



Name of animal	Type of habitat	Adaptive characters
Mole	Fossorial	Tapering head, clawed digits help in burrowing
Fish	Aquatic	Body compressed laterally and presence of fins, help in swimming, gills help in respiration
Bats	Aerial (Volant)	Forelimbs are modified into wings for flying, bones with air cavities to make body light.
Frog	Amphibious	Webbed feet for swimming, bulging eyes compensate for absence of neck, soft skin.



Name of plants	Type of habitat	Adaptive characters
Opuntia	Xerophytic	Leaves are modified into spines which help to reduce the loss of water, stems are succulent and green which carryout photosynthesis
Tomato	Mesophytic	Solid stem and freely branched, leaves variously shaped, generally thin and large.
Water lily	Hydrophytic	Floating leaves with long petioles with poorly developed root system.

On the basis of their observations the students may be helped to conclude that living things develop morphological and physiological changes over long period of time to increase its chances of survival and continuation of race.

C. Ecosystem and its Components

Concept 8: Interaction between living organisms (biotic component)and other non-living abiotic component of biosphere constitute the ecosystem.

Transactional strategy

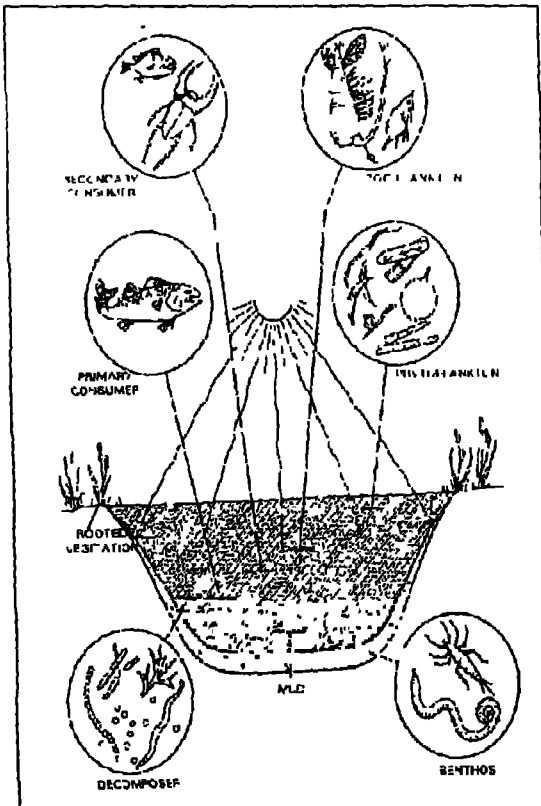
The concept of ecosystem can be explained to students by asking them to visit a pond or a lake or taking them for a picnic to a forest

Activity 9

Accompany students to a nearby pond or lake Ask students to note down various living and nonliving components they observe

Nonliving	Living
Soil, water and sun light falling on water surface	Algae, small insects, snails, crabs, small fishes, big fishes, snakes, frog, floating plants, rooted plants

The students may be asked to draw a diagram of pond showing above components and find out their relationship with each other



Pond as an ecosystem.

From these illustrations, students may infer that an ecosystem contains living and nonliving components The living component has a set of interacting species. The nonliving components include rocks/soil, water, air, sunlight and temperature The students may be helped to understand the importance of plants (producers) in an ecosystem and how they convert solar energy into chemical energy during photosynthesis.

Concept 9: The sequence of who eats whom in an ecosystem is called a food chain. All ecosystems have complex feeding networks, made up of many different food chains. This feeding network is called a food web.

Transactional strategy

The concept of food chain can be introduced by asking students questions based on their observations such as

Fill in the blanks:

a) _____Contains chlorophyll, which helps to trap solar energy and convert it into chemical energy
i) Algae ii) Grass iii) Trees iv) All green plants

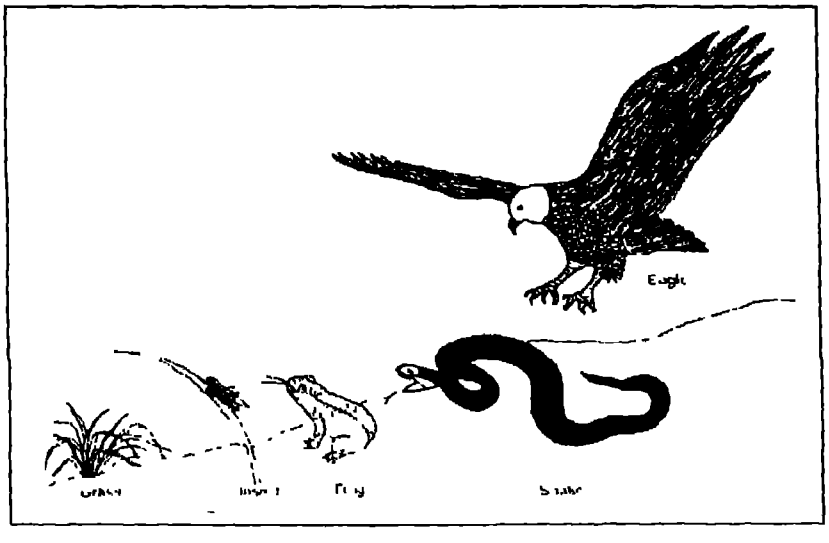
b) Green plants synthesize carbohydrates during photosynthesis and are called _____
i) consumers ii) producers iii) herbivores iv) decomposers

c) _____ eat grasses and are called herbivores
i) Rabbit ii) Dear iii) Insects iv) All of these

d) Frogs eat _____and are called primary carnivores
i) grasses ii) fishes iii) insects

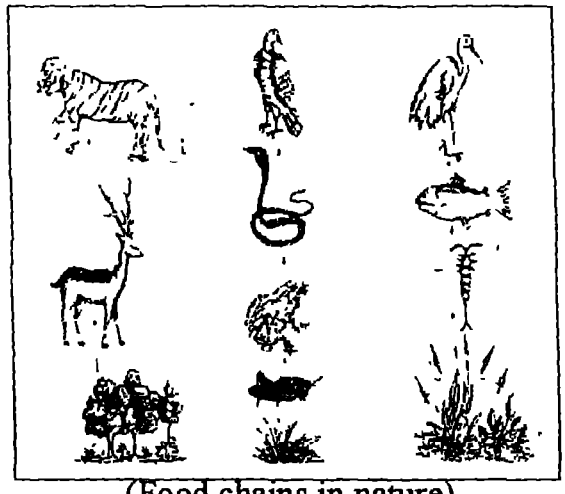
e) _____eat frogs and are called secondary carnivores.
i) Snakes ii) Dear iii) Goat

Students can be asked to draw linkages between (a), (b), (c), (d) and (e)



(A five step food chain in a grass land ecosystem)

Now students may be asked to prepare number of food chains of different habitat, such as aquatic, grass land, Forest, desert etc

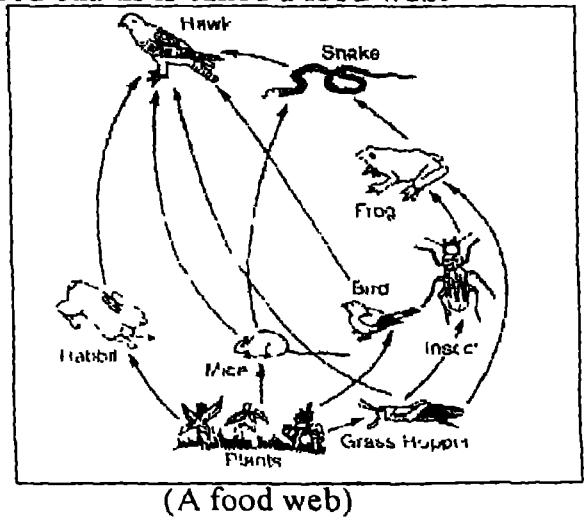


(Food chains in nature)

On the basis of students responses they may be helped to conclude that directly or indirectly all organisms depend on plants for their food Animals that eat plants are called herbivores Animals that eat herbivores are called carnivores Higher carnivores eat lower carnivores These way food linkages are formed between plants, herbivores and carnivores These food linkages are called food chains. Since plants prepare their own food, they are called **autotrophs.** Animals depend on plants and other animals for their food and are called **heterotrophs.**

Activity 10

Ask students to draw number of food chains of a particular habitat and then interlink them according to feeding habit. This network of interconnected food chains is called a **food web.**



(A food web)

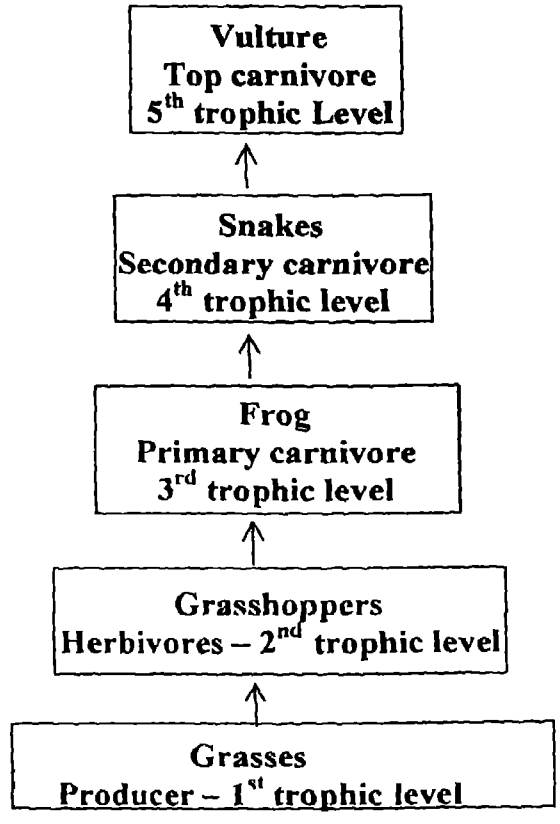
From the above illustration, students will be able to understand that in a food web, each organism occupies a specific position, whether it is a producer, a herbivore or a carnivore One organism may occupy positions in more than one food chain, for an organism can obtain its food from different sources and in turn may be eaten by different types of organisms

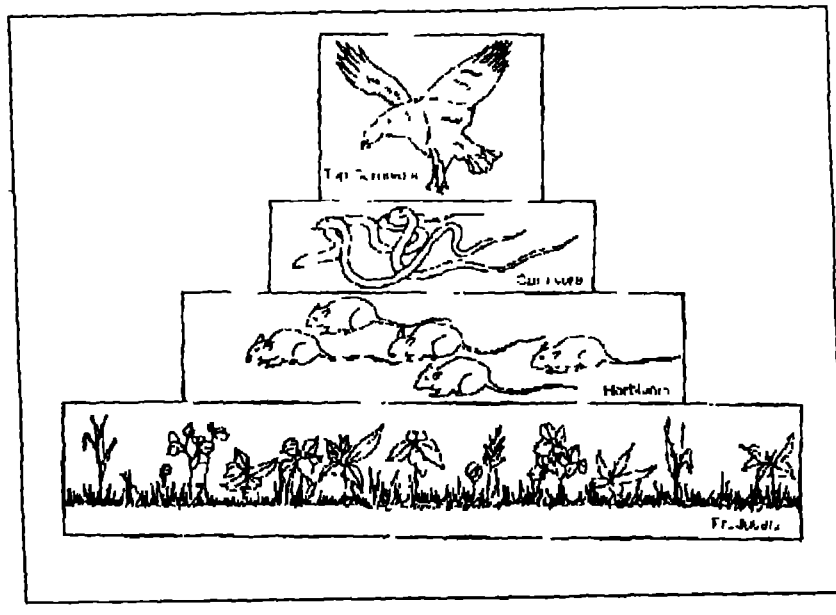
Students would also understand food relationship and interaction among various organisms in an ecosystem The mechanism of transfer of food energy and nutrients through various components of nature also can be understood.

Concept 10: The various Levels or steps in a food chain at which the transfer of food (or energy) takes place from one organism to another are called trophic Levels

Transactional strategy

The concept of trophic levels and transfer of energy can be explained to students by asking them to analyse food chains they have studied





Pyramid of numbers in a grassland showing trophic structure

The students may be explained; the green plants, which are autotrophs called producers, form the first trophic level. The herbivores or primary consumers forms the second trophic level. The animals that feed upon herbivores (primary carnivores) constitute the third trophic level. Top carnivores which feed upon primary carnivores form the fourth trophic level and so on

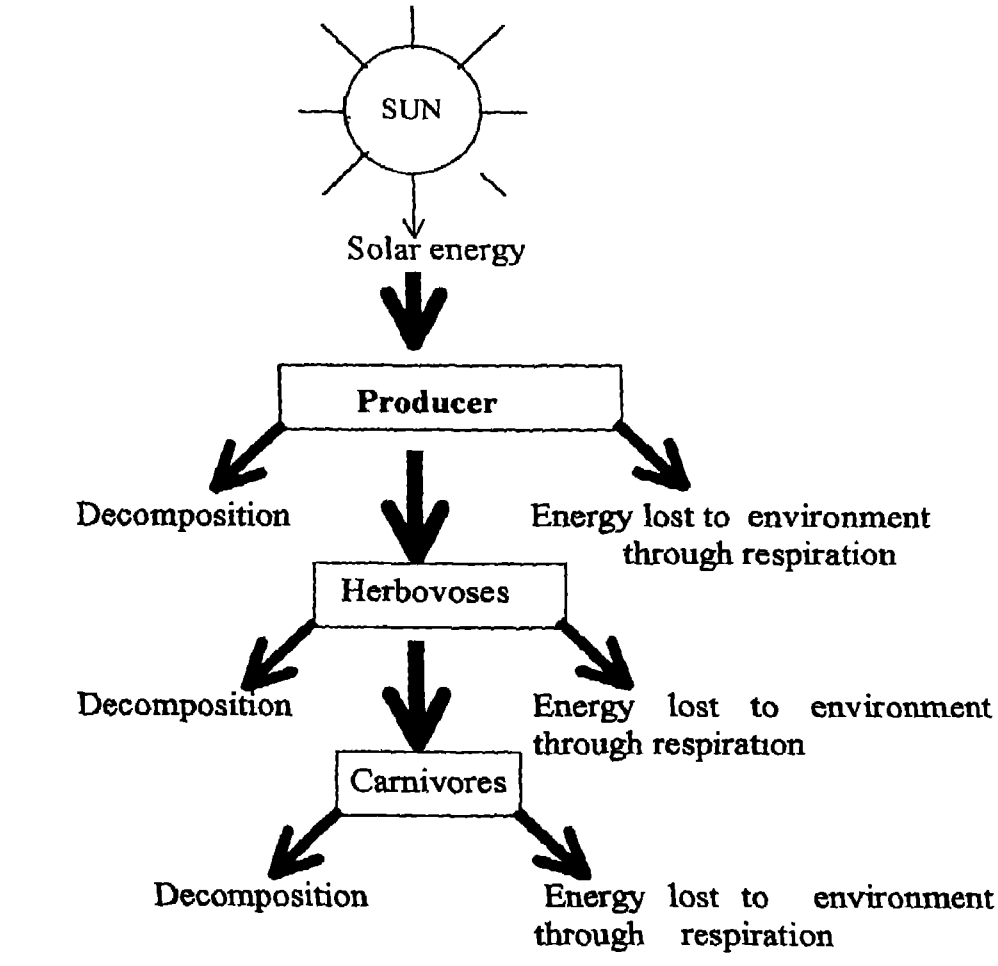
Energy flow in Ecosystem:

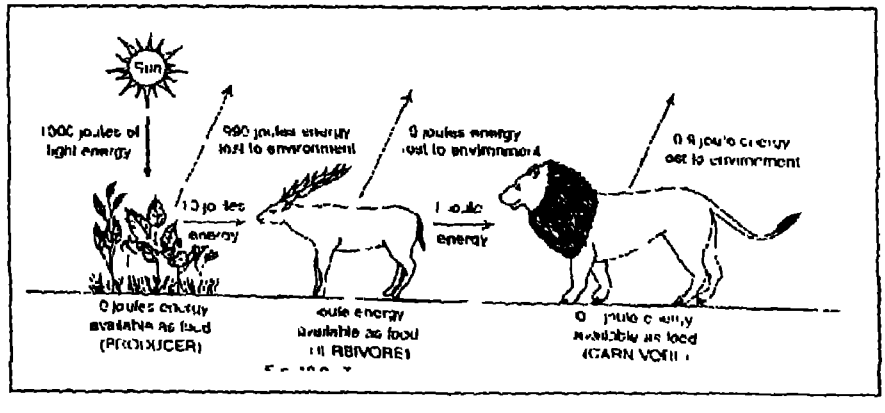
Concept 11: Energy flows from sun, through producers to consumers in a single direction only

Concept 12: There is a loss of energy as heat at each trophic level, the amount of energy available at each successive level goes on decreasing. The energy available is maximum at the producer level.

Transactional strategy

You can help students to understand the concepts related to energy flow in food chain through discussion and debate





(Energy flow in ecosystem—10% law in a food chain)

Students have learned in the earlier sections that plants prepare their own food using solar energy, air and water Plants produce food for

herbivores and are therefore producers while herbivores in this case are consumers When carnivores get their food from herbivores, carnivores become secondary consumers.

Students may be explained that out of the enormous amount of solar energy only a very small fraction is transformed by plants into chemical energy (carbohydrates) by the process of photosynthesis You may further ask what happens to this energy in producers (plants) The probable answer would be for growth You may explain to them that energy is utilised by plants for their metabolic activities Only a small part of energy is used up in respiration and for growth while a major portion of the energy is not utilised and is released to environment as heat When herbivores consume the producers, chemical energy stored in plants is transferred (with food) to them In herbivores, some energy is transformed to heat which is lost to the atmosphere, some energy is utilized in respiration and some is stored in tissues. Here students may be informed that about 90% of the energy is used up at each trophic level and only 10% of it is transferred to the next trophic level

On the basis of this discussion, the students may be helped to conclude that there is maximum energy at the producer level and as you go further and further the energy in food goes on decreasing at each trophic level

D. Biogeochemical cycles

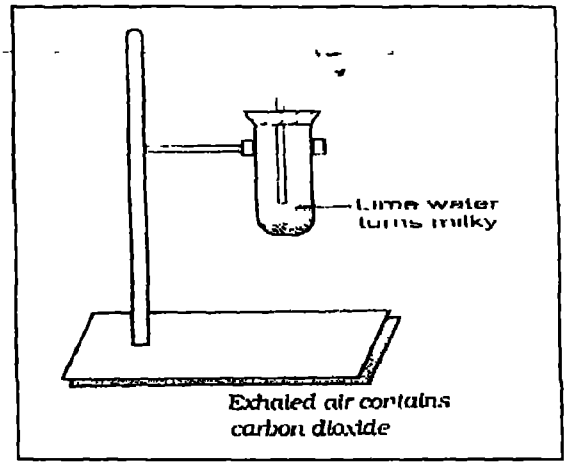
Concept 13: Nitrogen, Oxygen and carbon dioxide of air circulate in nature through biochemical cycles called nitrogen cycle, Oxygen cycle and carbon cycle

Concept 14. Oxygen cycle is the circulation of Oxygen in and out of living things

Concept 15: Carbon cycle is the circulation of carbon from the environment into the living things and then back to environment.

Transactional Strategy

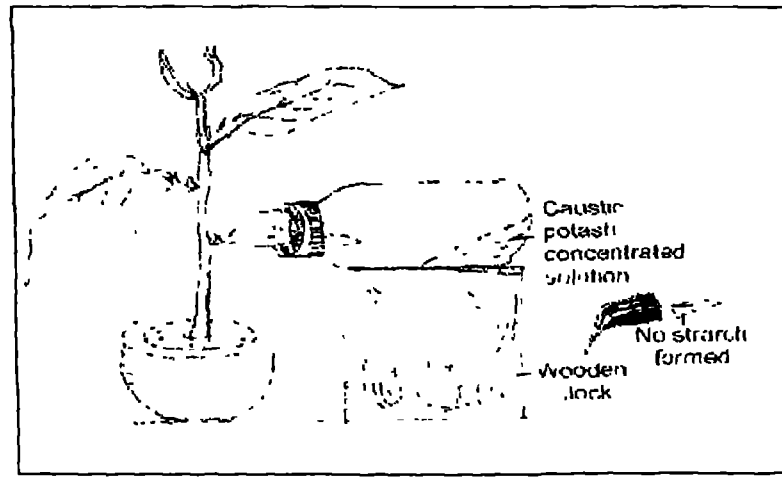
The Oxygen cycle and carbon cycle can be discussed simultaneously Students may conduct activities as illustrated here to understand which constituents of air are used by plants and animals



(Exhaled air contains carbon dioxide)

Activity 11

Take limewater in a test tube. Fit in a delivery tube through a cork as shown in figure above. Now blow out air from mouth into the limewater. What do students observe? The limewater turns milky. Students may infer that we breathe out carbon dioxide.



(CO_2 is required for preparation of food by plants)

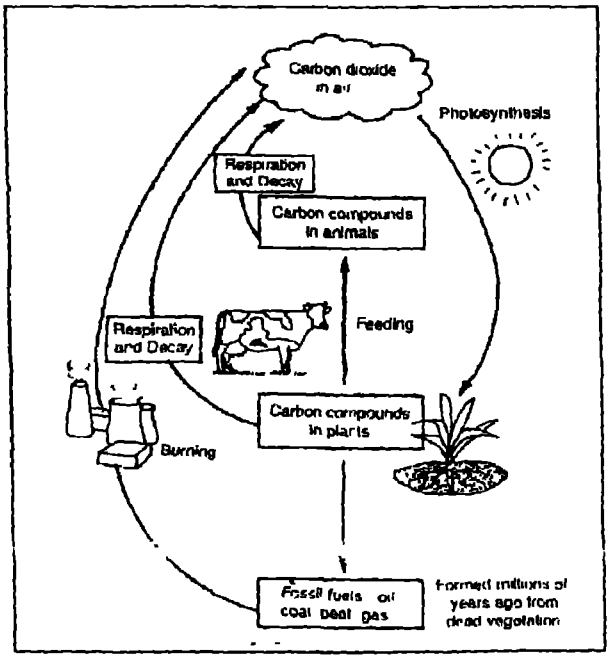
Activity 12

Keep a potted plant in a dark room for two/three days When the plant is still in dark, insert one leaf of this plant between the halves of the stopper without plucking the leaf from the plant A part of leaf should be out of the cork on both sides as shown in above figure. Take 10 ml of custic potash solution into a small reagent bottle and close the mouth with the stopper having the leaf in its centre. Now keep it in the sunlight for a day or two Then remove the leaf from the stopper and pluck it from the plant Put iodine solution over both halves of leaf Students will observe that the portion of leaf, which was kept inside the cork, did not change its colour Students may conclude from the observations that –

a) Leaves prepared no food when plant was placed in dark.

b) Part of leaf getting carbon dioxide prepared food but part of leaf not getting carbon dioxide could not prepare food, when placed in sunlight.

You may further explain the process of carbon cycle with the help of a chart as shown below.



(Carbon cycle in nature)

Respiration can be represented as food (carbohydrate) + Oxygen → Carbon dioxide + water + Energy

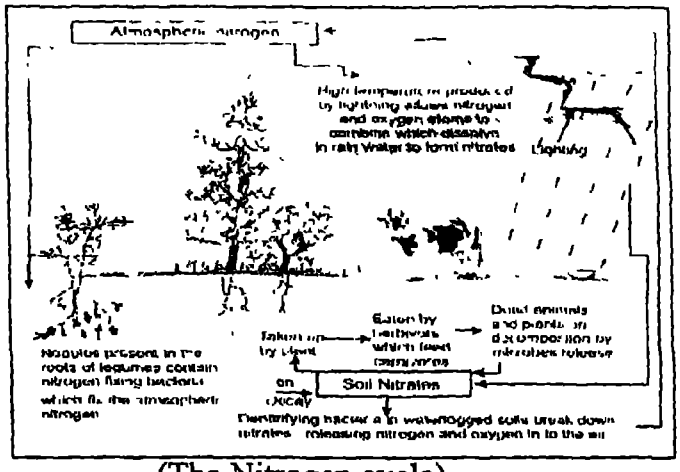
Preparation of food by plants (photosynthesis) can be represented as
Carbon dioxide + water + Energy → Food (carbohydrate) + Oxygen

Animals and plants use the oxygen given out by plants during photosynthesis during respiration Plants use the carbon dioxide exhaled by animals during respiration. In a balanced ecosystem Photosynthesis and respiration will keep the oxygen and carbon dioxide levels in the atmosphere steady. In reality, this is not as simple The burning of fuels to run vehicles, industries and other commercial and domestic purposes give off large quantities of carbon dioxide, which mix up in the air. Also burning of fuels consumes a large quantity of oxygen from atmosphere. Cutting of trees and deforestation curbs the supply of oxygen to the atmosphere.

Concept 16: The circulation of nitrogen compounds in the environment is called the nitrogen cycle.

Transactional Strategy

The concept of nitrogen cycle can be explained with the help of a chart as shown below. All living organisms-plants and animals need nitrogen because it is necessary for protein formation including DNA However, organisms cannot use nitrogen directly Animals require oxygen in an organic compound Plants including algae and bacteria can take up nitrogen either as the nitrate ion (NO_3) or the ammonium ion (NH_4^+) The atmospheric nitrogen gets converted to nitrate or ammonium ion by plants or by lightning. Lightning produces high temperatures which allow nitrogen and oxygen atoms to combine. These oxides of nitrogen dissolve in rainwater to form nitrates. Nitrogen fixing bacteria in humus and in root nodules of leguminous plants e g peas, beans etc convert atmospheric nitrogen to nitrates The soil nitrates are taken by plant roots. Plants are eaten by herbivores and herbivores by carnivores The dead plants and animals and droppings (urine and faeces) decomposed by fungi and bacteria release nitrates into the soil When bacteria in waterlogged soil denitrify soil nitrates, nitrogen and oxygen are released into the atmosphere. Students may also appreciate the importance of growing leguminous plants for nitrogen fixation and the role of decomposers in nitrogen fixation

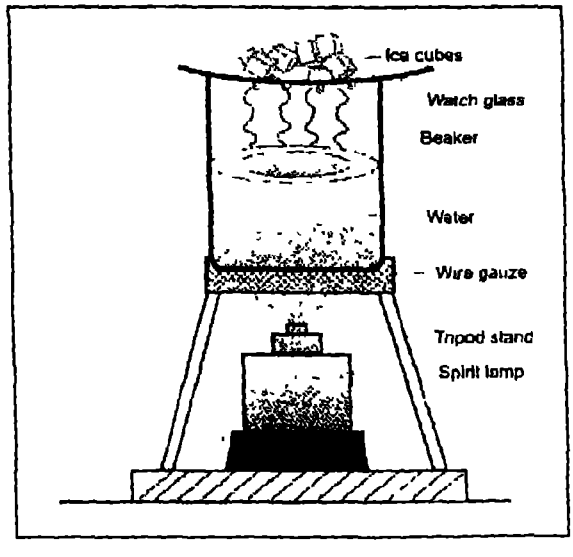


(The Nitrogen cycle)

Concept 17: The water cycle is a ceaseless process of water circulation from ocean, river, pond, lake, soil, plants and animals to air and from air back to ocean, river, pond, lake and soil.

Transactional Strategy

To help students to understand the cyclic process of transfer of water from atmosphere to land to oceans and back to atmosphere. You can design activities as illustrated here.



(The Rain formation)

Activity 13

Fill one-third of the beaker with water. Place a watch glass containing some ice cubes to cover the beaker Now heat water in beaker. Students will observe water vapours rising from water surface in beaker When water vapours strike the watch glass These condense to form water droplets, which fall back in the beaker. You can further explain to the students that in the same way, water evaporates from the surface of oceans, rivers, ponds, lakes, soil and vegetation. Sun warms up the air near the surface of the earth. This warm air containing water vapour rises up At higher altitudes atmospheric temperature is low. When water vapour cools at higher altitudes, minute water droplets are formed which fall back on earth as rain. You can illustrate water cycle with the help of a chart as shown below

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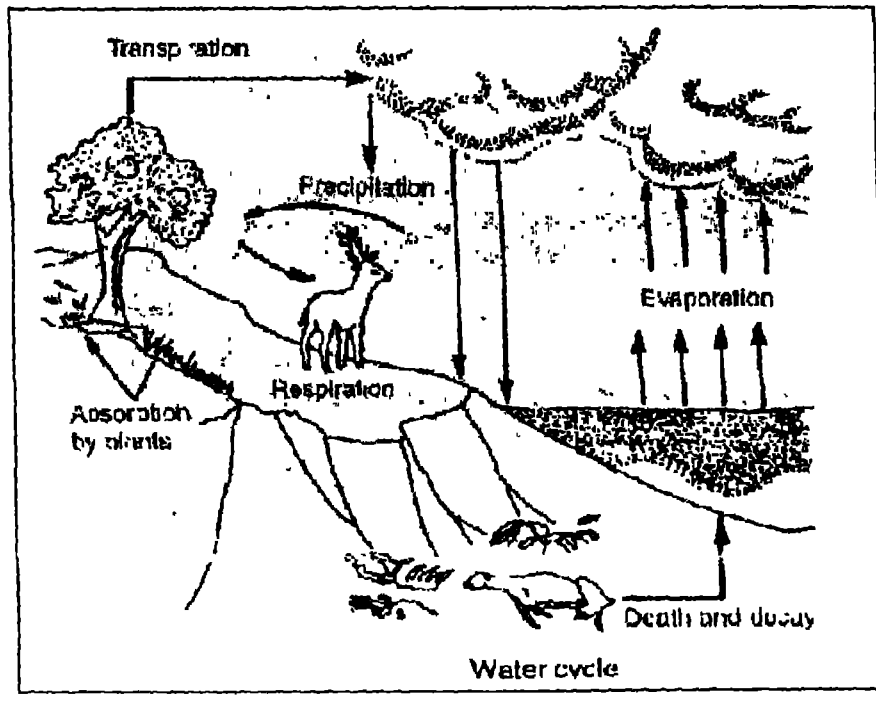


(The Water cycle)

E. Pollution

Concept 18: Water pollution refers to the degradation of water quality due to physical, chemical or biological substances (called pollutants).

Transactional Strategy

You may make students existing concepts explicit by asking questions such as why river water taken directly from river is not fit for drinking Why we should not throw garbage or dead organisms into rivers/ponds? What harm can industrial wastes do if thrown into a river? You will obtain a variety of answers from students Let students discuss their ideas and finally you can conclude the discussion as illustrated in the table:

S. No.	Pollutants	Source	Effects
1	Dead organic matter	Dead animals & plants· raw sewage & agricultural wastes thrown in rivers.	Diseases such as cholera
2	Pathogens	Human and animal excreta	Water born diseases such a cholera
3	Inorganic chemicals (P, N, mercury, acids and so on)	Phosphorus & nitrogen from agricultural land (fertilizers) and heavy metals from industrial wastes	Damage ecosystem and cause human health problems
4	Organic chemicals her-bicides. Dye industrial waste. Hospital and pharmaceutical wastes.	Agricultural use of pesticides	Ecological damage and human health problems
5	Radioactivity	Nuclear power industry, minerals & natural resources	Health problems

Concept 19: Air pollution refers to the addition of such substances to the air and in concentrations sufficient to cause harmful effects to health, crop or property.

Transactional Strategy

Students must have experienced that burning of fuel wood , garbage, coal and diesel produces smoke which mixes up with the air While traveling by road, the smoke emitted from vehicles causes irritation in eyes and respiratory problems They might have also experienced that burning of crackers on Diwali produces smoke, which causes suffocation and irritation in eyes. Based on student's experiences, you may ask them to list the sources of air pollution and the pollutants emitted from these sources With the help of pupil participation, you may draw a table on the black board as illustrated in table below:

Source of Pollution	Pollutants
Vehicular traffic	SO_2, NO_2, CO, SPM, Hydrocarbons
Industries	Lead, Aluminum, CO, SO_2, NO_2, CFC, SPM
Domestic	SO_2, NO_2, CFC, CO, SPM
Power plant	SO_2, NO_2, SPM

You may further discuss with them the harmful effects of these pollutants Sulphur dioxide and nitrogen oxides cause respiratory problems and irritation in eyes Lead can damage kidneys and nervous system; suspended particulate matter (SPM) is also associated with respiratory problems. Pollutants like benzene are carcinogenic, that is, it can cause cancer. Pollutants also harm vegetation. Pollutants are responsible for phenomenon like acid rain, global warming and ozone depletion.

Concept 20: Acid rain is the phenomenon where some gases present in the atmosphere such as CO_2, NO_2 and SO_2 combine with water drops to form acids and make rain acidic.

Transactional Strategy

Students might have observed that metallic statues or decorative metal pieces on buildings even metallic name plates on their doors or show pieces in their houses get corroded and tarnished Why does this happen? How do you clean if a copper coin or utensil turns green? Students have learnt that air contains carbon dioxide, sulphur dioxide and nitrogen oxide Automobiles and industries are the main source of these gases Carbon dioxide dissolves in water to form a weak carbonic acid Sulphur dioxide

forms sulphuric acid and nitrogen oxide forms nitric acid when dissolved in water Rain washed down these oxides and becomes acidic You can illustrate this phenomenon with the help of a chart as shown earlier.

Acid rain affects plants, soil, water and aquatic life It may be of interest for teachers to know how acid rain affects plants and soil Magnesium is an important constituent of chlorophyll Acid directly damages the leaves, kills the microorganisms present in soil and is responsible for leaching of soil nutrients (leaching means dissolving in water and getting washed away) Acidic rain affects water and aquatic life Acidic water is harmful for fish and other aquatic animals. Acid rain falling on slopes dissolves metals like aluminum in the soil. Some of these metals are toxic to organisms

Concept 21: Global warming refers to the increase in the average global temperature of the atmosphere near earth's surface.

Transactional Strategy

Students know that the main source of energy and temperature for earth is sun You can explain the phenomenon of global warming using students prior knowledge. Sunlight that reached earth, warms the atmosphere and the surface of earth. Earth's atmosphere system then re-radiates heat as infrared radiation Water vapour and several other gases, including carbon dioxide, methane and chlorofluoro carbons (CFCs) warm Earth's radiation They trap some of the heat energy radiating from Earth's atmosphere because they absorb and re-emit atmospheric system. The trapping of heat is somewhat analogous to green house effect and is called the **Green House Effect** Students can do the following activity to understand the concept of green house effect.

Activity 14

Take two wide mouthed glass containers of about 2 liters volume Cover one glass container with a glass plate and leave the other container open. Place one thermometer in each of the containers. Cover outside of containers with the newspaper Keep both the containers in hot sun for about three hours Measure the temperature in both the containers. Students may infer on the basis of their observations that

a) The container covered with glass plate has more temperature compared with the open container

b) Glass cover admits solar radiation but prevents all the heat waves from going out of the container by either reflecting them or absorbing them and reemitting a large portion back inwards

c) The glass cover prevents convection currents from mixing the cooler air outside with the warm air inside

Gases which trap heat energy are calaled gren house gases The pollutants CO2, SO2, N2O, CFC, CH4, O3 are greenhouse gases and are responsible for global warming The main source of these pollutants is burning of fuels and gases emitted from industries CFCs are produced in air conditioning and refrigeration work

Concept 22: Ozone depletion refers to the thinning of ozone layer in the stratosphere.

Transactional Strategy

This concept has been included in this module for enhancing teachers knowledge ozone (O3) is a triatomic form of oxygen, in which three atoms of oxygen are bonded. Approximately 90% of the ozone in the atmosphere is found in stratosphere about 25 kms above the earth This ozone layer in the stratosphere is called **ozone shield** because it absorbs most ultraviolet radiation that is potentially damaging to life. In the lower atmosphere, ozone is a pollutant produced by photochemical reactions involving sunlight, nitrogen oxide, hydrocarbons, and diatomic oxygen The ozone balance is illustrated in figure.

Ozone concentration in the stratosphere has been decreasing. Significant ozone depletion over the Antarctica has been reported and this is called **ozone hole**. There is not an actual hole in the ozone shield where all the ozone is depleted, but rather a relative depletion in the concentration of ozone that occurs during the Antarctic spring

One of the hypothesis is that ozone in the stratosphere is being depleted by the presence of chlorofluorocarbons (CFCs) The CFCs emitted in the lower atmosphere by human activities are stable ad non reactive at lower atmosphere Because CFCs have a long residence in the lower atmosphere and because the lower atmosphere is fluid with abundant mixing, the CFCs move upward and enter the stratosphere There, they may be destroyed by highly energetic solar ultraviolet radiation This process releases chlorine, a highly reactive atom The reactive chlorine released may then enter into reactions that deplete ozone in the stratosphere Massive destruction of ozone was identified and reported at Antarctic first in 1985 Since then, Antarctic ozone hole The amount of depletion has varied from

about 15% to 80% Under natural conditions, the highest concentration of ozone is found in the polar regions and the lowest near the equator

Concept 23: Air pollution needs to be reduced.

Transactional Strategy

You can use charts and models as teaching aid for teaching how air pollution can be checked You may ask students to list the areas in their locality where air pollution is more and if they could suggest the ways to reduce pollution Elaborate your discussion starting from students responses and list the main points on black board For example, most students know that vehicular pollution due to burning of diesel and petrol is one of the main causes of air pollution You can further tell them that we have rules and acts for automobile pollution check. It is necessary and mandatory to get your vehicles checked for emission of pollutants every three months. Students might have also heard about lead free petrol and sulphur free diesel. These reduce air pollution and we should use clean fuel in our vehicles. We also have rules and acts on polluting industries Polluting industries should not be located in residential areas The recycling of wastes reduces pollution to some extent.

You can reduce harmful pollutants in the air. For example, by using smokeless chulas for cooking. Do not smoke and also do not allow others to smoke and also do not allow others to smoke in public places. In some places like Delhi, Government has banned smoking in public places. Burning of garbage and materials like tyres produces harmful pollution and their use should be checked. You may motivate students to become responsible citizens and observe the rules for pollution check

For assessing the progress of pupils learning. You can assign them some project work, which they can do in groups For example preparing charts and models on Carbon cycle Nitrogen cycle and Air pollution. You may also ask them questions of the type

a) Explain that acid rain is an environmental problem
b) Explain the factors, which disturb the nitrogen cycle in nature.
c) Explain how respiration and photosynthesis balance the oxygen-carbon cycle in nature

Check your progress- III

You may check your progress by solving questions such as

i) What are the harmful effects of ultraviolet rays and how are these related to ozone depletion?

How deforestation and burning of trees disturbs the carbon-oxygen cycle?

Electricity its heating, magnetic and chemical effects

Dr. S.K. Paradkar
Reader in Physics

The main effects produced by electric current are heating, magnetic and chemical and voltage drop across resistive conductors These effects don t care about the amounts of positive and negative particles, or about their speed, their mass charge etc even the direction of charge flow If hundred positive particles flow left per second, this gives exactly as much magnetism, heat produced and voltage drop as hundred negative particles flowing to the right per second (This is perhaps because reversing the polarity of the particles reverses the current, and reversing the particle flow direction reverses the reverse current) Magnetism heating and the voltage drop together represent nearly every feature that is important in everyday electrical circuitry So far as most electrical devises and circuits are concerned, it makes no difference if the current is made of positive particles going one way or the negative particle going the other way or half as many negative particles flowing backward through a crowd of half as many positive In other words, the "Ampere" doesn't care about the direction or speed of the flowing particles

So to simplify our measurements and our mental picture of electric currents, we cut away the unused parts of the picture We internationally define particles flowing in one particular direction

We don't care about their real polarity, speed & number, we ignore both the chemical effects and the effect of the velocity and direction moving particles. We ignore collisions between the particles negative and positive All we care about is the total charge, which moves past a particular point in circuit

Electric charge is a component of atoms In other words, after we have broken an object into molecules, and broken the molecules in to atoms, when we break the atoms apart we discover particles of electric charge Charge is material, it is like atoms but it is one step lower than atom We can say that solid objects are made of electric charge, object are made of equal quantities of positive and negative charge, and objects stay together because of the attraction between then quantities of opposite charge inside them Chemical bonds are a attraction & repulsion result of charge Chemical bonds are electrical in nature Electric charge is a "fundamental", property of matter

When these charges moves, what do we call it?, well, if the positive and negative charges move along together, we call it "physical motion" Since matter is composed of charge carrying particles, all physical motion is a motion of charge But in most cases both the negative and the positive charges moves along as one When opposite charges moving along together, that is called "mechanical", whole opposite charges moving separately altogether differently are electrical If the negative charge in an object should start moving while the object's positive charge stay at rest, then we call that motion an "electric current" The words "electric current" mean the same as "charge flow"?

Electric current is flow of energy ? **Wrong.**

Electric current is a flowing motion of charged particles Electric current is a very slow flow of charges (≈ 6mm/sec) the charges moves at approximately a few mm/sec) on the other hand electrical energy is made of fields and it moves very rapidly(electromagnetic waves travels at the speed of light) Electric energy moves at a different speed than electric current so obviously they are two different things

Here is an appropriate analogy and a way to clarify the concepts if electric current is like a flow of air inside a pipe , then the electrical energy is like sound waves in the pipe, an electron are like the air molecules Sound can travel through a pipe if the pipe is full of air molecules, and electrical energy can flow along a wire because the wire is full of (electrons) movable charges Sound moves much faster than wind. Correct ? An Electrical energy moves much faster than electric current for much the same reason Air on a pipe can flow fast or slow, while sound waves always travel at the same very high speed Charges on a wire can flow fast or slow, while electrical energy always flow along the wire at same incredibly high speed

Whenever sound is flowing through a pipe, the air molecules in that pipe are vibrating back & forth When waves of AC electrical energy are flowing along a wire, the electrons in that wire are vibrating back & forth 60 times per second What if we were all taught that sound and the wind are the same things?

But be careful, since the description above is just an analogy and sound waves are not exactly like electrical energy For example, sound can flow inside an air filled tube, while electrical energy always flows in the space outside of the wire, and does not travel along within the metal wire

Electric energy is composed of electric and magnetic fields, and it exists in the space surrounding the wires Electrical energy is similar to radio waves, but it is very low in frequency The charge flow (Current) is a flowing motion usually of electrons and electrons are material particles not energy particles And it is not always a flow of electrons, when electric current exists inside an electrolyte (in batteries, salt water etc)
It is the flow of charged atoms or ions Current is a matter flow, not an energy flow It is important to realize that wind is not sound

A very common mistake found in the textbook is to speak of "flow of current ", current it self is the flow of charge, what then, could "flow of current" means? If charge is like air then electric current is like wind, or if charge is like water than electric current is like "gallons per second" liters per second of water flow more precisely the rate at which charges flow There is another analogy i e "fluid" If charges are water then the rate at which water flows is a current (i e gallons per second or liters/sec) simply water flows doesn't convey the true meaning of the current

If we consider the effect of electric current then we always say that any current carrying wire there is a magnetic field associated with it We never discuss about the electrical effect but we always talk about magnetic effect of electric current Why? What happens to the electric field? Why we do not discuss the electrical effects? The answer lies in the structure of atoms of which the material is composed of i e atom as a whole is neutral i e it consists of as many negative charges (electrons) as well as positive charges (Protons) The answer to this question lies here that at any point out side the wire the electric field due to all positive charges are opposite to that of negative charges hence at any point out side the field the net electric field

will be zero Hence we do not talk about electrical effect of electric current, but we talk about magnetic effects of an electric current

There is another misconception about electricity i e Electric charges only flows on the surfaces of wires? Which is wrong During DC in a simple circuit, the flow of charge takes place throughout the whole wire If the level of current is very high, then the wire will become hot, and the current will heat up the inside of the wire as well as its surface To avoid overheating we should use thick metal bar instead Heat energy is actually the electrical energy (work done) in moving the charges from on point to another in the electric field Work will be done when there is some opposition to the flow of charges (electrons, protons) positive ions etc this opposition to the flow of electrons is offered by the structure of the material (nature of material) Copper offers less opposition to the flow of charge particles a compared to alloys, nichrome constantan magnin etc This opposition to flow of charge carriers is termed as electrical resistance and this is responsible for heating of a wire when electric charges are forced to flows through a wire This is also closely related to voltage or potential difference Electrical potential is the potential energy stored in the electric field when charges flows (charges are forced to moves in a resistive wire

What is voltage? How is it different from potential or potential difference?

Of several electricity concepts, the ideas of "voltage" or potential difference are the most difficult concept to comprehend Voltage is a way of using numbers to describe an electric field Electric fields or "E-fields" are measured in volts over a distance, volts per centimeter for example A stronger e – field has more volts per centimeter than a weaker field Voltage and e-field are basically the same thing if e-fields are like the slope of a mountainside, then the volts are like the various heights of each different spot on the mountain The slope of a mountainside can make a boulder start rolling So can the differing heights of the different points on the mountain, it's just another way to describe the same thing "Voltage" and "e-fields" are two ways to describe the same basic concept

"Voltage" or " electric potential" is one way that we can measure an electric field To produce a very high voltage rub a balloon on your head, or scuff your shoes upon the floor when the humidity is very low

Electric fields can push or pull upon electric charges so electric forces are caused by Voltage In a battery circuit, the voltage from the battery causes the charges of the wire to flow Voltage caused current Some people are of the opinion that voltage is a sort of "electric pressure"

From the physicist's point of view , potential difference refers to the inequality of charges results from chemical reactions inside the battery (the Separation of positive and negative charges and their accumulation on opposite sides)

Potential difference is the origin of electric current, that is, it is the origin of the motion of the free electrons already present on the conductor to replace the missing electrons at the positive battery terminal Potential difference, resulting from electrochemical reactions inside the battery, has a constant value Students, as well as most non – professional in the field tend to share the opposite point of view, that is, to view electric current as the origin of potential difference, and in their operation potential difference as a mere measure of electric flow, more or less synonymous with current (Cause effect relationship)

There are some usual suggestions by physicists is to abandon the term "electricity" and start out with as much correct terminology as you think appropriate for the age level of the student

- ✓ We don't produce "electricity", we study "electrical science"
- ✓ Generators don't produce "electricity", they produce electrical energy more correctly they convert one form of energy in to electric form which is made of invisible field (electric & magnetic fields) resembling radio waves that whiz along outside of the wires A generator also forces the charges of the wire to flow
- ✓ "Electricity" doesn't flow in wires. "charges" do in fact charges are made or forced to move along the wires
- ✓ Batteries don't supply "electricity", wires do A battery is a chemically fueled charged pump Like any other pump, a battery does not supply the "stuff" that it pumps. When a battery runs down, it is because its chemical fuel is exhausted, not because any charges have been lost
- ✓ Light bulbs – doesn't consume "electricity" Instead, the charges of filament (substance / material/along) are forced to flow fairly fast, and this heats the filament because of a sort of "electrical function" Charges flow in, but than they flow back out again & none are used up
- ✓ Avoid saying "Static Electricity" and current electricity"
  Instead call them charge imbalance and charge flow or possibly voltage. electromotive force and current

Magnetism:-

So far in our study if the magnetic fields produced by current carryings conductors We have assumed that the surrounding space was vacuum If matter is present, howere. the magnetic field can be very different Classically, we imagine electrons in atoms to undergo circulatory motions, creating microscopic magnetic dipoles field of their own In certain substances these dipoles can be aligned so that they contribute greatly to the resultant magnetic field

The origin of the magnetic properties of materials is within their atomic structures For our purposes, we may consider an atom to be made up of a positively charged nucleus with electron circulating in orbits about the nucleus These microscopic current loops create magnetic dipole fields In addition, we assume that each electron also "spin" about its own axis. similar to a spinning top, producing a "spin" magnetic dipole moment The resultant magnetic moment Pm of the atom is due partly to the orbital motions of the electrons and partly to their spins There is a tendency for all the individual dipole moments within a single atom to combine in pairs. with opposite orientations so that the net magnetic dipole moment for the atom as a whole can be zero

Source *www.eskimo.com ~billb miscone miscon.html*

1 Why is electricity impossible to understand? A collection of various ideas 1995 William J Beaty
2 what is voltage 1995, William J Beaty

The Rate of Reaction

1.1 OBJECTIVES

After completing this module the student will be able to

- define the rate of reaction.
- differentiate between fast and slow reactions and able to cite examples of different reactions.
- establish relationship between the change in concentration with change in time.
- derive the units of rates of reaction.
- distinguish between order and molecularity.
- recall different types of reactions and reaction rates (initial, instantaneous and average rates), specific velocity constant (velocity constant)
- understand the factors affecting the rate of reaction like- concentration, temperature, catalysis, surface-area and radiation
- refer the minimum amount of energy needed to bring about a chemical reaction (activation energy)
- recall the postulates of Arrehenius theory.

1.2 OVERVIEW

Chemical kinetics is based on the study of rates of chemical reaction. In this topic, we concentrated first on rate of reaction, types of reaction rates, its unit, its dependence and its mathematical formulation Secondly we concenterate on Arrehenius theory and energy of activation

1.3 PREVIOUS KNOWLEDGE

(1) How will you define speed ?

(2) Define and explain the concept of velocity ?

(3) What are the different types of chemical reactions occurs when two substrate are mixed together ?

(4) What's the nature of reversible and irreversible reactions ?

(5) How much and how far a chemical reaction occurs ?

(6) What's the effect of temperature on rates ?

1.4 INTRODUCTION

Chemical reaction occur with his own speed Some reactions are fast and some reactions are slow. Silver nitrate solution with dilute hydrochloric acid immediately, we get a white precipitate whereas rusting of Fe takes time to get iron rusted In both reaction we observed that in the first one reaction is fast whereas the other one is slow Similarly when H_2 and Cl_2 are mixed to combine in dark reaction takes place very slowly On the other hand the reaction is allowed to take place in sunlight, reaction become fast If we heat potassium chlorate alone, we get oxygen, it takes a lot of time and more temperature is required If we add small quantity of MnO_2 as a catalyst to the above reaction - decomposition takes place fast and at low temperature as compared to previous reaction

From the above examples we infer that the different reactions not only takes with different rates but the rate is effected by temperature, concenteration, pressure and catalyst etc

We also infer that whether a particular reaction will occur or not with what velocities and what are the factors

In this module, we will study about rate of chemical reaction, factors affecting the rate of reaction

The rate of chemical reaction is defin in exactly the same way we defined the speed of a car

If a car has travelled 30 km in 30 minutes the speed relationship will be

(Distance travelled) / (time required for the travel)

= (Change in position) / (Time required for the change)

Likewise the rate of chemical reaction tells as to at what speed it occurs Let us consider a simple reaction

A ----------> B

The concentration of the reactant decreases as time passes Suppose the concentration of A at time $t_1 = [A]_1$ and time $t_2 = [A]_2$ Therefore the rate at which the concentration of A has changed may be expressed as

(Change in concentration of A) / (Time taken for the change) =

$([A]_2 - [A]_1) / (t_2 - t_1)$

If d[A] represents the change in concentration and dt the time taken for the change

Rate of reaction = $\delta A / \delta t$

Since the concentration of the reactant decreases $\delta[A]$ is a negative quantity Therefore if we measure the rate in terms of the change in concentration of one of the ractants we define the rate as $-\delta A/\delta t$

That is

Rate of reaction = $- \delta[A] / \delta t = + \delta[B] / \delta t$

Thus the rate of chemical reaction may be defined as

" **the change in the concentration of a reactant (or product) in a given time interval** "

Let us take for example

Specific reaction between Sulphur dioxide and oxygen (oxidation of

SO_2 into SO_3)

$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$

Rate of reaction can be determined by either measuring increase in molar concentration of product or by decrease in concentration of SO_2 and O_2 in a given time interval

$[SO_3]_2$ ... molar concentration $[SO_3]_1$ is molar concentration at final time t_2

When the change in molar concentration SO_3 is equal to

$[SO_3]_f - [SO_3]_i = \Delta[SO_3]$

time required for change = $t_2 - t_1 = \Delta t$

rate of formation of SO_3 = $\Delta[SO_3] / \Delta t$

However instead of measuring the increase of molar concentration of SO_3 we can equally measure the decrease in the concentration of SO_2 and O_2

Rate of decrease in concentration of SO_2 and O_2

$= - \frac{1}{2}\{\Delta[SO_2] / \Delta t\} = - \Delta[O_2] / \Delta t$

(-) negative sign appears because change in molar concentration of SO_2 and O_2 decreases as the reaction proceeds

(1) To summarise the rate of a reaction is change in concentration divided by the time needed for that particular changes

(2) Rate can be either measured by the reactant or by the product's concentration Since reactant decrease with time A reactant is negative whereas A product is positive

(3) The different expression for the rate can be made equivalent by dividing the rate expression by the stoichiometric coefficient in a balanced chemical equation Thus for a reaction $aA + bB \longrightarrow cC + dD$

Rate of reaction = $-(1/a)(d[A]/dt) = -(1/b)(d[B]/dt)$

$= +(1/c)(d[C]/dt) = +(1/d)(d[D]/dt)$

1.5 UNITS OF RATE

Reaction rate has the units of concentration divided by the time. We express the concentration in mole per litre But time may be given in any convienient unit seconds, minutes, hour, days etc

Therefore the units of reaction may be

- mole/litre/sec or mol l^{-1} s^{-1}
  mole/litre/min or mol l^{-1} m^{-1}
  mole/litre/hour or mol l^{-1} h^{-1} and so on

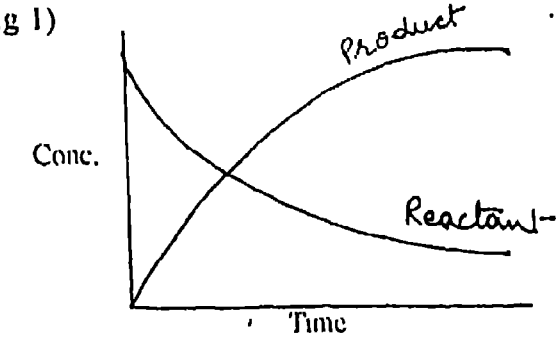
1.6 CONCEPT OF REACTION RATE

Let us consider the reaction of acetic acid react with methanol in an aqueous solution to form methyl acetate The reaction is represented by the following equation .

$$CH_3COOH + CH_3OH \text{ ---------} \rightarrow CH_3COOCH_3 + H_2O$$

The rate of this reaction can be measured by determining the rate at which methyl acetate is formed or the rate at which acetic acid disappears or rate at which methanol disappears

According to the law of mass action the rate of a chemical reaction depends on the concentration of the reactants As the chemical reaction proceeds further, the concentration of the reactants decrease with the passage of time and the rate of reaction also decreases. Similarly the concentration of products increases with the time. (fig 1)



Change in concentration of reactants and product with the passage of time

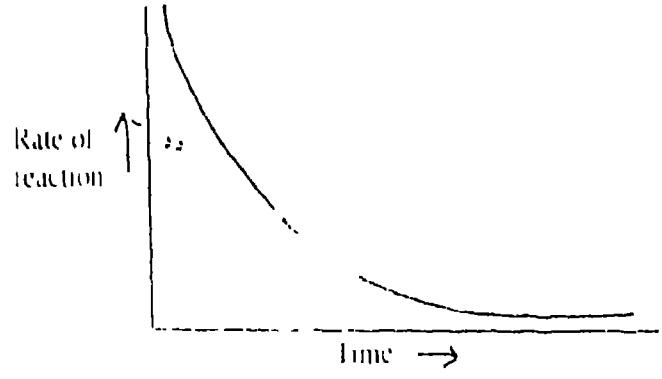


Fig. 2 Graph between rate of reaction and time.

Hence the rate of a chemical reaction generally doesn't remain constant but changes with the passage of time (fig 2)

From the graph (fig 2) it is also clear that the rate of reaction decreases very fast in the beginning then decreases slowly and in the end becomes very slow but not zero, but approaches zero.

It is therefore, irrelevent to talk about a general rate for a chemical reaction. Hence in place of general rate the rate of reaction may be expressed as three types

(1) Average rate of reaction.

(2) Instantaneous rate of reaction

(3) Initial rate of reaction

1.7 AVERAGE RATE OF REACTION

When a person move on bicycle the distance travelled by him in a definite time is divided by time, gives the speed of bicycle in the initial stage and in the end, while stopping is less hence the speed determined the way gives the average speed of bicycle This can be written as

Average Rate = (Change in concentration of reactants)/(Time taken in change)

= - Δc / Δt

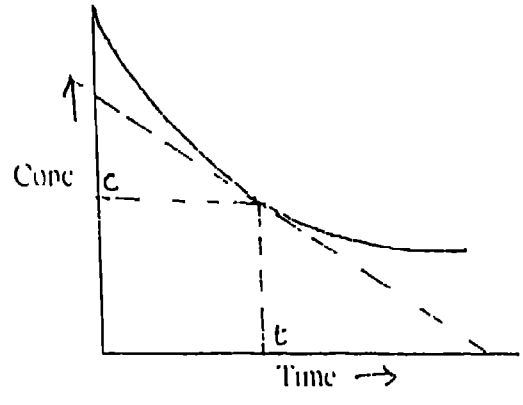
The negative sign shows that with the passage (increase) of time, the concentration of the reactant decrease and the rate of reaction decreases If the rate of reaction is expressed on the basis of increasing concentration of the product then the sign of the average rate of reaction would be positive Hence the average rate of reaction is expressed as follows

Average Rate = Δc / Δt

1.8 INSTANTANEOUS RATE OF REACTION

If we try to see the graph between concentration Vs time, with the passage of time the concentration of the reactant decreases and so the rate of reaction decreases

Instantaneous rate i.e the actual rate at any time is different from the average rate The instantaneous rate can be determined with the help of a curve plotted between the concentration and time on this curve, a tangent is drawn at any time t or its corresponding concentration C



The slope of this tangent at time t or concentration 'c' represents the instantaneous rate of reaction as shows in Fig 3

The instantaneous rate or the actual rate of a reaction is equal to the slope of the tangent drawn at a particular time, on the curve plotted between concentration and time The instantaneous rate is represented as follows.

Instantaneous rate $= -dc/dt$

Here, dc is extremely low change in concentration for extremely short time interval dt

The rate of reaction is defined as the rate of change of amount of a reactant (or a product) divided by the balanced equation of the chemical reaction For example, $A \longrightarrow 2B$

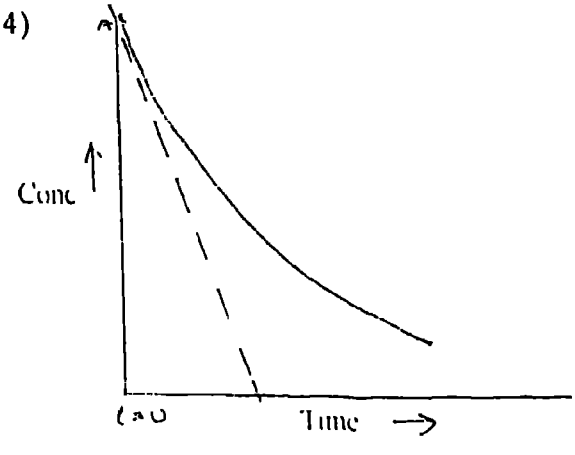
$$-\delta[A] / dt = + \tfrac{1}{2} \delta[B]/dt$$

In words,

Rate of disappearance or consumption of A = 1/2 [Rate of formation of B]

1.9 INITIAL RATE OF A REACTION

If at a point A where t = 0 a tangent is drawn for initial concentration on the curve plotted between conc Vs time The slope of tangent is called the initial rate of reaction (fig 4)



1.10 SPECIFIC REACTION RATE - (OR RATE CONSTANT)

According to the law of mass action rate is proportional to the molar

concentration of the reactant If the law is applied to the following reaction

$H_2 + I_2 \longrightarrow 2HI$

$d[HI]/dt \propto [H_2][I_2] \quad k[H_2][I_2]$

Where k = specific reaction rate or rate constant for the reaction

If the molar concentration of $[H_2]$ and $[I_2]$ is 1.0 M the measured rate would be equal to specific reaction rate Thus specific reaction rate or the rate constant for the reaction is defined as the rate for unit molar concentration of the reactant or reactants at that temperature

The value of k is independent of concentration of the reactants but its dependent on the temperature. At the fixed temperature k is constant and characteristic of the reaction Rate constant is a measure of the intrinsic rate of a reaction. Larger k indicates fast reaction and small k indicates slow reaction.

Unit of Reaction Rate and Specific Reaction Rate

Rate of Reaction = dx/dt = dc/dt = (Change in concentration)/(Change in time)

= Concentration $time^{-1}$

If concentration is expressed in terms of mole per litre and time in sec then

Unit of rate of reaction dx/dt = $(mole/lit)\ sec^{-1}$

= $mole\ lit^{-1}\ sec^{-1}$

= $mole\ L^{-1}\ s^{-1}$

For general reaction

$aA + bB + cC \longrightarrow$ Product

Rate of Reaction $= k[A]^a[B]^b[C]^c$

(concentration / time) = k (concentration)^a (concentration)^b (concentration)^c

$k = (concentration)^{1-(a+b+c)}\ time^{-1}$

1.11(A) ORDER OF A REACTION

Consider a general reaction $aA + bB \rightarrow cC + dD$

Where A & B are reactants and C & D are products Small a,b & c,d are stoichiometric coefficients for above reaction if rate law is rate $= k [A]^a [B]^b$, Where k is rate constant and [A] [B] are the molar concentration of the reactants A & B The exponents a & b are called order of reaction w r t A & B The sum a+b is known as overall order of reaction

For the reaction decomposition of N_2O_5 to form $NO_2 + O_2$ it has been observed that rate $= k [N_2O_5]$

The exponent of $[N_2O_5]$ is one therefore order of reaction w r t N_2O_5 is therefore one. Further, since only one concentration term is involved, the overall order is one. But if we look at the overall reaction represented as follows

$$2N_2O_5 \dashrightarrow 4NO_2 + O_2$$

it predicts the order should be two But experimentally it has been observed that order of above reaction is one Therefore following mechanism is suggested

N_2O_5 ----------> $N_2O_3 + O_2$ slow

N_2O_3 ---------> $NO + NO_2$ fast

$NO + N_2O_5$ ---------> $3NO_2$ fast

In the above mechanism step I is the slow step therefore the rate controlling step and hence the order of reaction is one as found experimentally

1.11(B) MOLECULARITY

Elemetary reaction may be described by their molecularity which specifies the number of reactant molecule that are involved in reaction steps. If a reactant 'A' decompose to product in a single reaction step as given below

A --------> Product

the reaction is unimolecular If two reactants A and B reacts with each other to products as given by reaction

A B ---- ---> product

the reaction is bimolecular An elementary reaction one in which the molecularity and the overall order of the reaction are same

1.12 Difference between order and molecularity in a complex reaction

Order	molecularity
1. Order refers to the overall reaction	1 Molecularity refers to an elementary step of the mechanism
2. Order is determined by experiment	2 Molecularity for a step is speculation.
3 Order may be integer (including zero), fractional and even negative The values may be any number between -α and + α but values between -2 to +3 are usually found in practice	3. Molecularity is always an integer (except zero) and never negative.

1.13 HOW FAST AND HOW SLOW ARE THE CHEMICAL REACTION

Chemical reaction may be fast and slow. rate of chemical reaction may be as slow as it may take million of years to complete or may be as fast as it may be completed in femto seconds (10^{-15} sec). The rate of reaction depends upon nature of reacting substances Usually it has been observed that the reaction in

which large number of bonds are broken or are formed are slow and reaction in which bond rearrangement doesn't take place or few bonds are broken are fast at room temperature

1.14 EFFECT OF LIGHT ON RATE OF REACTION

Number of reactions take place in presence of light Different steps of photosynthesis are example of this type of reactions In these reactions light provide enough energy to reactants so that they cross energy barrier easily The energy absorbed may be sufficient even to break chemical bonds and form highly reactive intermediate called free radicals Some of the examples where light is used for utilising chemical reaction

(1) Photosynthesis by plants
(2) Photochemical synthesis by compounds
(3) Preparation of blue prints
(4) Photography
(5) Sterlization of water (exposure of water to UV radiation)

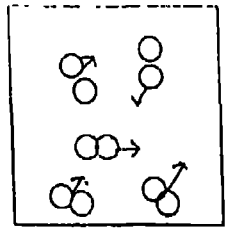
1.15 FACTORS AFFECTING THE RATE OF REACTION

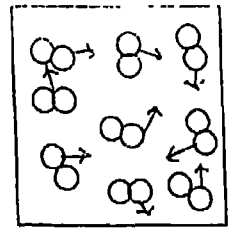
(1) <u>The nature of the reacting species</u> In a chemical reaction new chemical bonds are formed and old bonds broken Therefore, the strength of these bonds and their environments in the reacting molecules will affect the rate of the reaction Eg . The reaction of acidic solutions with basic solutions proceeds so rapidly as to be instantaneous On the other hand, the reaction of N_2 with H_2 molecules to form NH_3 molecules at room temperature in the absence of a catalyst take place so slowly as to be incomplete even after millions of years

$NaOH + HCl \longrightarrow NaCl + H_2O$

$N_2 + 3H_2 \longrightarrow 2NH_3$

(2) Concentration of reactants According to the law of mass action, the rate of reactants is proportional to the molar concentration of reactants, the rate changes with time because the concentration of various reactants decreases as time passes This illustrated by rusting of iron which is enhanced during rainy season when water vapour concentration in air is increased concentration increases collisions and hence increases reaction rates This is illustrated by these figures -





(3) Effect of Temperature Temperature has striking effect on the rate of chemical reaction . Reaction rate negligibly slow at ordinary temperatures may become appreciable and even explode at elevated temperature. As a very rough but useful rule the rate constant is developed for a rise in temperature of 10°C Thus a temperature change of 100°C may alter the rate more or less by a factor of $2^{(100/10)}$ or 2^{10} or 10^3 For example : the rate of decomposition of HI, the rate constant increases by a factor of 1.1 for each 10°C rise in temperature

According to Arhenius theory

$K = A.e^{-\varepsilon_0/KT}$

$\ln k = \ln A - (\varepsilon_0 / KT)$

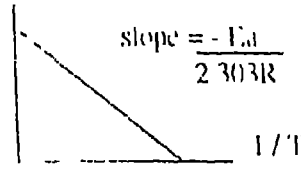
$2.303 \log_{10} K = -(\varepsilon_0 / KT) + \log_{10} A$

Therefore, $\log_{10} K = -\varepsilon_0 / (2.303KT) + \log_{10} A$

ε_0 = Arhenius activation energy, unit is energy/mole and A is a constant. The above reaction is called Arhenius equation. According to this equation if we plot a curve between logk and 1/T we find a straight line. To increase the rate of reaction we should increase the temperature of reaction, but

this rule is not valid for all types of reactions such as for endothermic reactions, we decrease the temperature of reaction to increase the rate of reaction For example, $N_2 + O_2 \dashrightarrow 2NO$

$N_2 + 3H_2 \dashrightarrow 2NH_3$



"For a chemical reaction at two different temperatures T_1 and T_2 the values of rate constants are k_1 and k_2, we show relation between these as follows

$$\log(k_1 / k_2) = -\{E_a / (2.303R)\}[(1/T_1) - (1/T_2)]$$

(4) Effect of presence of catalyst: When reactants are reacted together to convert a product, they must have sufficient amount of energy for collision, this energy is called activation energy i e energy needed by reactants atoms or molecules to activate them for collision is called activation energy, it also known as energy barrier

For a chemical reaction to proceed it is compulsory conditions to cross energy barrier i.e. their molecules must possess certain amount of energy greater than energy barrier if thay don't have, the chemical reaction is not done For these types of reactions, catalysts are playing as important role. If we mix a catalyst in this chemical reaction the reactant first react with the catalyst and form an intermidiate complex, which is converted into product and give catalyst as such This intermidiate complex is able to cross the energy barrier. In these types of reaction the value of activation energy is decreased so that reaction proceds fastly at low values of energy

(5) Particle size in heterogeneous system or exposed area Since heterogeneous reaction occur only at the surface boundary between the reacting phases, the rate of such reaction is proportional to the surface area. When a given mass is subdivided into smaller particles, the surface area is increased,

Activity based Teaching of Reflection, Refraction and Optical Instruments

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Overview:

Students are familiar with light when they come to school They known sun, bulb and lamp as source of light Light is a form of electromagnetic radiation that causes the sensation of sight. Infact, it is an indispensable tool without which we cannot explore the colourful beauty of Nature. Light enables us to see objects in this beautiful world around us Light also provides us means of communication The fibre optic cables transport hundreds of telephone conversations over long distances Many optical phenomena around us can be understood if we consider nature of light as wave Phenomena of reflection, refraction and dispersion of light shall be learnt through activity based Teaching i e learning by doing N C.F 2000 has highlighted the importance of activity based teaching in the meaningful learning. We shall also study the structure and working of optical instruments such as human eye, microscope and telescope. In order to enable the learners to imbibe the basic concepts of light, some activities will be performed during the curriculum transaction

Objectives:

- To acquaint the phenomenon of reflection, refraction and dispersion of light
- To perform some simple activities to show reflection of light by mirror, refraction of light through glass slab and dispersion of while light by glass prism
- To describe the structure and working of optical instruments such as eye, microscope and telescope.

Concepts/teaching points

- Optical phenomena observed around us can be accounted for wave nature of light.

- The angle of incidence (i) is always equal to the angle of reflecting (r) and the incident ray, the reflected ray and the normal to the mirror at the point of incidence all lie in the same plane
- The phenomenon of bending of ray of light when passes from one medium into another medium is called refraction of light
- The ratio of sine of angle of incidence (i) to the sine of angle of refraction (r) is constant and is called the refractive index of the second medium with respect to the first medium
- Splitting of white light into its different constituent colours on passing through a prism is termed as dispersion of light
- A lens is a piece of transparent medium enclosed between two curved surfaces or between one curved surface and other one plane surface
- A normal human eye is able to see both near and distant objects clearly
- Some people can not see distant objects clearly and some can not see nearby objects clearly
- Systematic arrangement of two convex lenses of appropriate focal lengths can magnify an object to an extent and this system of arrangement is acts as a compound microscope
- Systematic arrangement of two convex lenses of appropriate focal lengths can be applied to see distant object clearly and this arrangement works as a telescope

Concept: The angle of incidence is always equal to the angle of reflection. The incident ray, the reflected ray and the normal to the mirror at the point of incidence, all lies in the same plane.

Activity –I

Step I Mount the plane mirror (M) and fix a pin in front of it

II. Made adjustment as shown in fig 1, such that the pin is visible through all the four slits

III Mark by pencil to obtain the path of light

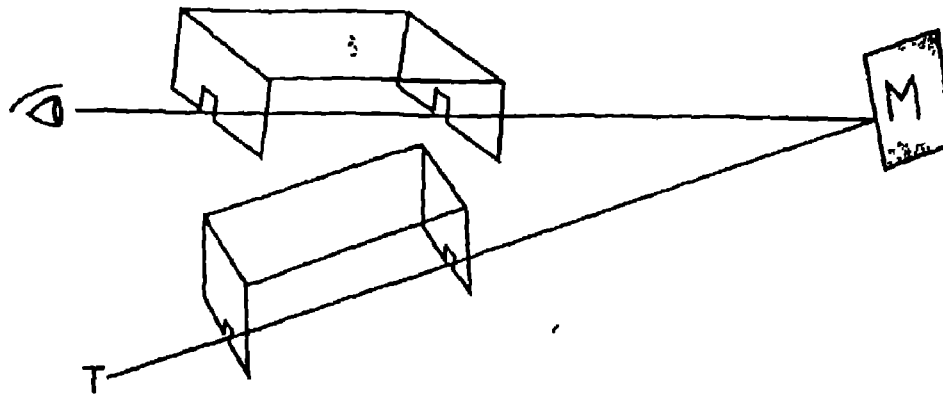


Fig. 1

An alternative traditional experiment of using four pins to observe laws of reflection can be also be performed (Fig.2)

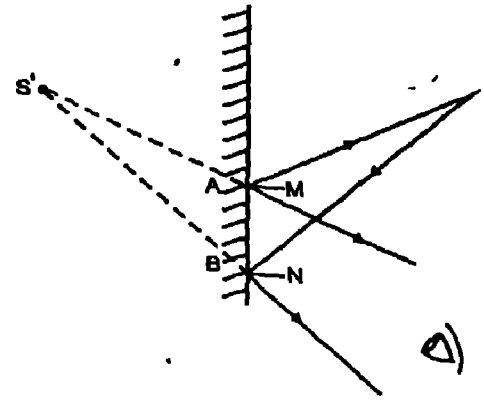


Fig. 2

Learners should be helped to draw the following inferences

- the distance of the image from the mirror is equal to the distance of the object from the mirror
- to obtain the position of the image, at least two rays are used in the diagram

Are the laws of reflection equally applicable to curved mirror at the point of reflection

Concept: The phenomenon of bending of ray of light when it passes from one medium into another is called refraction of light.

Activity - 2

Step I Take an opaque container and place a coin at its bottom

II. Ask one of the learners to stand aside and see the coin at the bottom Then ask the learner to slowly move away from the container till the coin just disappears from view

III. Now pour water into the container till the coin reappears back into view to that leaner from exactly the same position.

Correct explanation may then be given by drawing following ray diagram Fig 3 showing the bending of a ray of light when it goes from water into air Since the rays are going from a denser medium (water) to less denser (rarer) medium (air) the ray AC and AD bend away from the normal in directions CF and DF respectively and when produced backwards appear to be coming form point I Thus the coin kept at position A appears to be raised to position I to the observe. point I in called the virtual image of object, the coin in this case

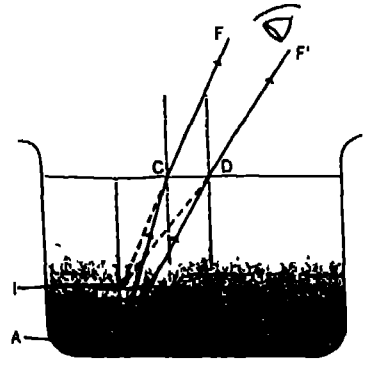


Fig. 3

Why does the coin become visible when observed from exactly the same position when water is poured in the container?

Activity – 3

Learners may be asked to perform the following activity on tracing the path of a ray of light through a rectangular glass slab (Fig 4)

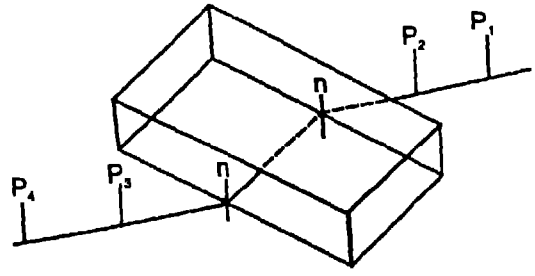


Fig. 4

Step I Place a rectangular glass slab on a piece of paper on a table and fix two pins P1 and P2 on one side of the slab

II Now ask one learner to observe from other side of the slab and ask him to place two more pins P3 and P4 on other side of the slab in such a way that all the four pins appear to be along a straight line.

III Remove the slab and complete the path of ray of light as shown in Fig 4

IV Learners may be asked to change the angle of incidence and then observe the corresponding angle of refraction

V. Record their observations in the tabular form as given here.

S. No.	Angle of incidence (i)	Angle of refraction (r)

The learners may also be helped to draw the following inferences from above observations

- Is the angle of incidence equal to the angle of refraction?
- What is the value of angle of incidence and angle of refraction when the ray of light is incident normally at any point of surface of separation of the two media?
- Can be determined refractive index through above activity?

Concept: Splitting of white light into different constituent colours on passing through a prism (dispersive medium) is called dispersion of light.

Activity - 4

Step I Take a narrow beam of light and make it fall on one of the faces of a glass prism.

II. Hold the prism by making slight adjustments in such a way that different colours are observed on a screen held nearby.

III Learners may be helped to observe these colours by repeating the activity and write their observations.

The terms 'Dispersion of light' and 'spectrum' may then be introduced and explained with the help of the following diagram

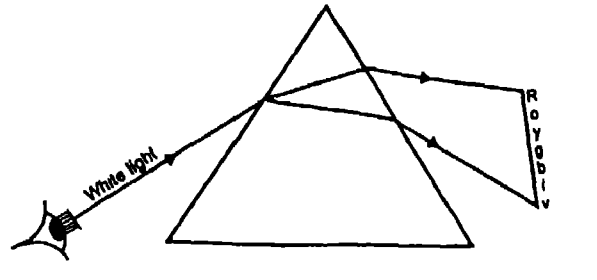


Fig. 5

Activity – 5

Step I. Take the learners in the ground and ask them to see a distant object, such as a tree or a building

II Now ask them to look at some nearby object Let the learners feel that they are able to see both near and distant objects clearly With the help of diagrams help the learners to understand that when we see distant objects the eye lenses relax and become thin However, as soon as we focus an eyes on any nearby object, the eye lens become thick, thereby reducing its focal length to form a distinct image on the retina

Concept: Some people can not see distant objects clearly and some people can not see near objects clearly.

Through discussion, learners may be helped to recall that some of their classmates can not read the black board clearly, though they can read their books without any difficulty In such cases the image is formed in front of the retina (Fig. 8(a)). This defect of eye is called nearsightedness or myopia Through discussion, learners may be helped to understand that this defect can be corrected by the use of spectacles fitted with concave lenses (Fig 8 (b) The concave lens diverges the rays to bring them to focus on the retina.

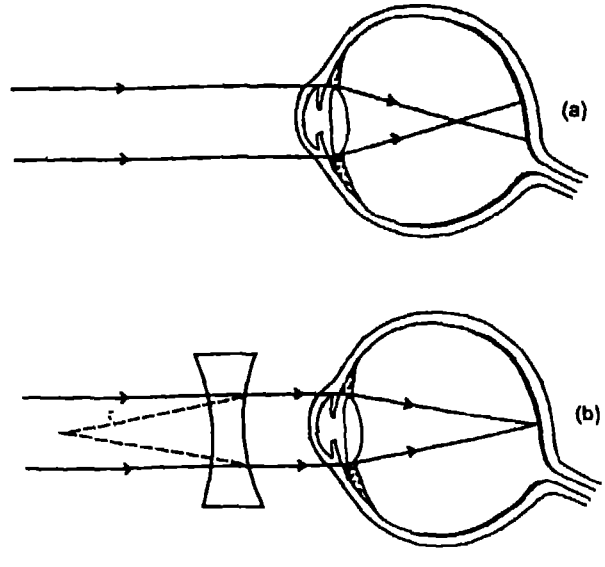


Fig. 8

Concept: A normal human eye is able to see both near and distant objects clearly.

Learners may also be helped to recall that some people cannot see nearby objects clearly. In such cases the image of nearby objects is formed behind the retina (Fig. 9 (a)). The defect is called farsightedness or hypermetropia. Through discussion, students may be helped to understand that this defect can be corrected by the use of spectacles fitted with convex lenses (Fig 9 (b)) The convex lens converges the rays so as to focus them on the retina

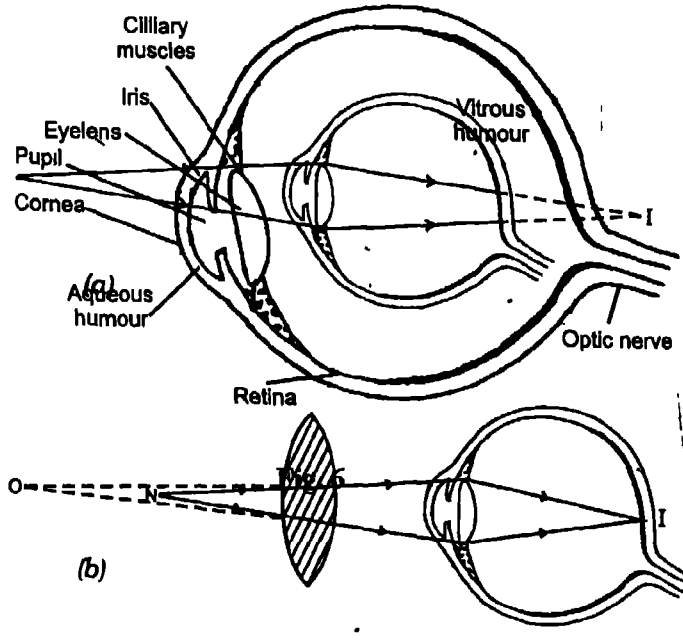
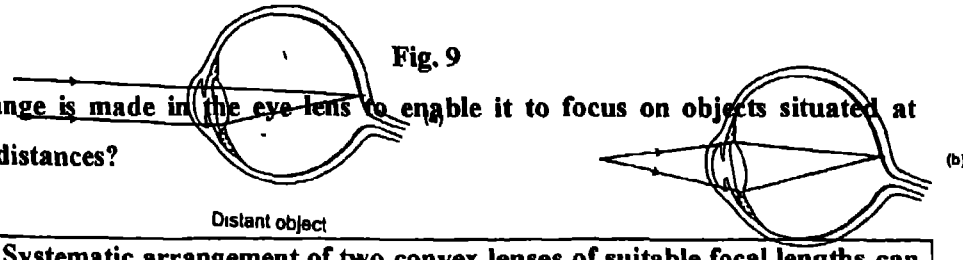


Fig. 9

What change is made in the eye lens to enable it to focus on objects situated at different distances?



Concept: Systematic arrangement of two convex lenses of suitable focal lengths can magnify a given object to a large extent and the system works as a compound microscope.

With the help of knowledge gained by the learners particularly in relation to the size of the image in relation to the position of the object, explain to them as to how much higher magnification of the object can be produced by adjusting two convex lenses some

distance apart on the same axis The function performed by each lens may be explained The terms objective lens and eye piece may be introduced and the learners may be helped to draw following ray diagram (Fig 10) to show the image formation in such arrangement of lenses Such a system of lenses is called compound microscope

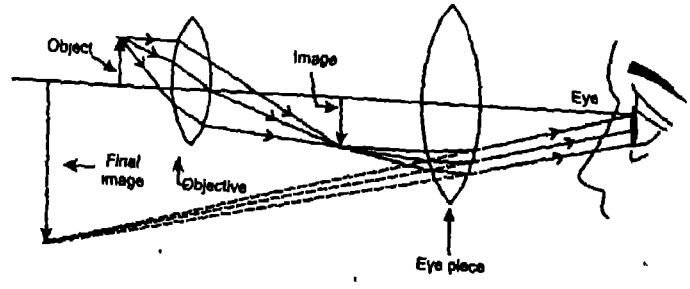


Fig. 10

Activity – 6

Take a compound microscope from Physics laboratory and use it to show a magnified image of an object which cannot be seen clearly with naked eye Ask questions related to objective lens, eye piece etc The activity may be repeated in small groups Following question may be asked to clarify the underlying concepts further

On what factors does the magnification produced by the compound microscope depend?

Concept: Systematic arrangement of two convex lenses of suitable focal lengths can be used to see distant object clearly and the arrangement acts as a telescope.

With the help of knowledge gained by the learners, explain to them as to how two convex lenses of appropriate focal lengths be adjusted co-axially to see a distant object clearly The objective lens forms a real image of the distance object The eye piece then forms virtual and magnified image of the first image (Fig 11) Such an arrangement is called an astronomical telescope

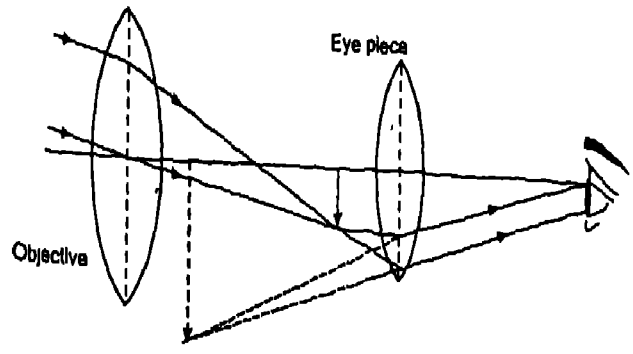


Fig. 11

Activity – 7

Take a telescope from Physics laboratory and ask the learners to see distant object using it Ask questions related to objective lens and eye piece. The activity may be repeated in small groups

Reflective questions

- Could we survive, if there were no sun light on the earth? Discuss it
- Why do we see rainbow?
- Which one of the colours obtained in dispersion of light bend most?
- Why white light does not show dispersion incase of glass slab?
- Name the type of lenses used in the spectacles of a person whose eye lenses can not see nearby objects clearly?
- A compound microscope and astronomical telescope have been kept side by side How will you distinguish between the two?

Teaching of Heat by Demonstration method

Ved Prakash Arya
Lecturer in Physics,
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Concept 1. We cannot sense hotness or coldness properly
Materials required

Three pans, water and any source of heat

Preparation

Take three pans, one containing hot water, the second Luke warm and the third cold

Observation

Place your one hand in hot and the other in cold water for some time Then place both your hands in leek warm water. What do you feel?

After demonstration learner will be able to answer the following:

→ What do you observe?

→ Why both hand feels different sensation in same pan?

→ By which quantity, we can sense hotness or coldness of a body?

→ Why it is necessary to make thermometers to measure temperature?

Concept 2. The quantity of heat required to warm a given substance depends on its mass, the change in temperature and the nature of the substance.

In this demonstration, teacher will take two beakers, source of heat water and mustard oil or any other liquid

It will be find out how the amount of heat is affected by

(a) The mass of the substance

(b) Increase in temperature

(c) Using different substances

The experiment will test your skills in

(a) designing tests which are fair

(b) measuring temperatures and times accurately.

(c) Presenting results in a table

(d) Drawing conclusions from observations.

Materials required

Two identical beakers, heating source, two thermometers, stop watch, water and mustard oil

We are going to carryout tests on two beakers containing water In the first, we have to find out the effect of different amount of water on heat required for the same temperature increase In the second, we have to find out the effect of different temperature increase on heat required for same amount of water In the third, amount of substances and temperature increase both are same and we have to see the effect of the nature of the substance

Preparation

First Test Take different amount of water in two beakers and raise the temperature of both water in the beakers by same amount say 15^0C

Second test Take same amount of water in both beakers, but raise the temperature of two by different amounts say 5 and 15^0C

Third test Take two different liquids of same amount and also raise the temperature of two by same amount Remember water must be stirred throughout the tests

Making the tests fair

For the tests to be fair, it is needed to make sure that the beakers are of the same size and shape Both beakers contain the same water Both beakers are in the same part of the room, away from droughts and sunlight Some type of thermometers are used

Source of heat is giving constant burning of fuel

Observations

Test – I

Rise in Temperature =

Amount of water in beaker 1	Time required for temperature rise	Amount of water inbeaker 2	Time required for same temperature rise

Test – II

Amount of water taken =

Time required for raising the temperature by 5^0C	Time required for raising the temperature by 15^0C

Test – 3

Amount of liquid =

Rise in temperature =

Time required for liquid 1	Time required for liquid 2

Drawing conclusions:

To know that amount of heat observed depends on which factors, you could.

Compare the time taken for the different amount of water

Compare the time taken for the different raise in temperature

Compare the time taken for the different types of liquid.

After demonstration, learner will be able to answer the following;

→ What is the dependence of amount of heat required to warm a given substance on its mass?

→ What is the dependence of amount of heat required on rise in temperature?

→ Does amount of heat required to warm a given substance depends upon the nature of the substance?

Concept 3. Latent heat is used in transition of phase and does not increase the temperature of the substance.

Materials required:

Beaker, Ice, thermometer and source of heat.

Preparation

First, we take an ice piece into a beaker and then we give some heat energy constantly to the beaker and heat it until the temperature of water becomes 100^0C

Observation

This is observed that in spite of heat being given to water, its temperature remains 0^0C until whole ice is converted into water Likewise, when temperature of water increases upto 100^0C, the temperature of water remains 100^0C, until whole water is converted into steam.

After demonstration, learner will be able to answer the following

→ What is the effect of absorbing heat by any substance?

→ During melting of ice, why temperature remains at 0^0C in spite of heat is being supplied?

→ For water, where heat energy is being used?

→ During boiling of water, why temperature remains at 100^0C in spite of giving heat?

→ At 0^0C and 100^0C, where heat supplied is being used?

→ What type of heat, it is said?

→ Why latent heat of steam is greater than the latent heat of ice?

Concept – 4: When two liquids of different temperatures are mixed together then an exchange of heat will be there and heat lost by one substance will be equal to the heat gained by other substance.

Materials required

Two measuring flasks, cold and hot water, thermometer

Preparation

First we mix some amount of water in a measuring flask and shake or stir it for some time.

Observation

Mass of hot water	T_1 of hot water	Mass of cold water	T_1 of cold water	T of mixed water	Heat lost by hot water	Heat gained by cold water

After demonstration, learner will be able to answer the following:

→ When we mix two liquids of different temperatures, what type of interaction between two is taking place?

→ What is the effect of mixing on hot water?

→ What is the effect of mixing on cold water?

→ Why final temperature is same for both water?

→ What is the value of heat lost by hot water?

→ What is the value of heat gained by cold water?

→ What is the relation between heat lost and heat gained?

Concept 5: Boiling point of water depends upon the vapour pressure. When vapour pressure is lowered, the boiling point also decreases and when vapour pressure is increased, the boiling point also increases.

Materials required

A flask with cork having thermometer inside it, beaker and water, source of heat

Preparation

First, we boil water and put this boiling water in the flask, close it by a mouth cork and wait for some time Thermometer is put in the flask trough the cork such that water doesn't come out of the flask. After some time, we pour some cold water over the flask This process is repeated after some time

Observation

When we pour cold water over the flask containing hot water, the change in the water inside the flask is observed and temperature of water inside is recorded through thermometer After some time, again temperature at the changing process of water is measured

After demonstration, learner will be able to answer the following:

→ What is the boiling point of water at pressure 1 atmos?

→ Why bubbles are formed, when cold water is poured over the flask?

→ At this time, what is the temperature of the water inside flask?

→ Why temperature of inside water is decreasing?

→ Why boiling occurs by cooling of water inside?

→ Is there any dependences of boiling point on the vapour pressure? If yes, then what type of dependence is there?

→ Why it is easier to cook food in pressure cooker?

→ Why it is difficult to cook food on mountains?

→ Why operation instruments are sterilized by placing them in high-pressure vaporizers?

Concept 6: All substances expand upon heating and contract upon cooling

Materials required

Flask, water, $KMnO_4$, balloon, Glass tube, Metal sheet having hole, source of heat

Preparation

Test – I We take a metal sheet having circular hole in it and heat it

Test – II Fill a flask with a liquid (for instance, with water), close the flask with a plug with a glass tube passing through it and heat the liquid in the flask Some $KMnO_4$ is also added into water

Test – III We take a balloon and partially inflate it and then place it in warm water and then again in cold water

Observation

In test-I, we observe that a hole in a metal sheet increases exactly like the circle of identical diameter drawn on an intact sheet

In test-II, by heating the liquid in the flask, the level of the liquid in the tube will rise If the liquid is cooled, the level will drop

In test-III, size of the balloon will increase when it is placed in warm water and it would start shrinking when it is placed in cold water

After demonstration, learner will be able to answer the following:

→ What is the effect of heating on substances?

→ Why hole in a metal sheet increases?

→ What will be the shape of square in a metal sheet, when heated it?

→ Why level of liquid in the flask rises?

→ What flask or liquid, expanded more?

→ If level of liquid in the flask does not rises, then what can you say?

→ Why current of $KMnO_4$ starts flowing in the flask?

→ when water is heated from 0^0C to 4^0C, what will happen?

→ Why volume of water is lowered, when heated from 0^0C to 4^0C?

→ Why size of balloon increases when placing in warm water?

→ Why the platinum alloy wires don't crack the glass when the bulb heats up?

→ Why telephone wires are left slack when hung between poles?

→ Why concrete roads have bitumen filled gaps across them?

→ Why steel can be used to rein force concrete?

→ If you are filling a bottle with a drink, why should you leave a space at the top before putting on the cap?

→ Why fish in a lake can survive a harsh winter, even though the surface of the lake is frozen?

→ Why a beach ball may burst if left in the sun?

→ Why air bubbles come out of an empty washing – up liquid bottle if you hold it in hot water without squeezing?

Concept 7: Water vapours is present in the atmosphere and amount of water vapours present in the atmosphere is measure of relative humidity of any particular place. If at a given temperature, $1m^3$ of air holds m kg of water vapour while it could hold m_s kg on saturation. The quantity $m/m_s x100$ is called relative humidity.

Materials required

Ice cold water, plastic bottle

Preparation

We take some ice cold water in a plastic bottle

Observation

We observe that some water drops are now present on the surface of the bottle

After demonstration, learner will be able to answer the following

→ What does the water on surface of the bottle indicates?

→ From where water vapours come in the atmosphere?

→ What do you mean by saturated air?

→ Why clothes dry easily in Ajmer in comparison to MUMBAI?

→ Mass of water (kg) contained in $1m^3$ of air saturated with water vapour (at normal pressure)

Temperature (^{0}C)	10	20	30	40
Mass of water (10^{-3}kg)	9 3	17 1	30 0	51 0

If $1m^3$ of saturated air at 40^0C is cooled to 10^0C, from table given above, find out how much water will condense?

PROJECT METHOD

Meaning :

Project is a group activity perform by a set of person

Definition

"Project is a whole hearted purposeful activity proceeding in a social environment "

स्टीवेन्स के अनुसार – 'योजना एक समस्यात्मक कार्य है जो अपनी स्वाभाविक परिस्थितियो के अन्तर्गत पूर्ण किया जाता है।

The objectives of Project Method :-

1. To develop scientific attitude among the students.
2. To develop self confidence among the students.
3 It help in developing creatine ideas among the students.
4. It motivates about a subject.
5 This method help in developing experimental skill of handling apparaties.
6 This method help in developing team spirit among the student
7. This help in budgeting the time

Merits of Project Method :

1 It helps in making curriculum flexible.
2 This method help to teacher student both to plan the activity.
3 This method help in impervising of apparatus.
4 This method help in achieving the important objectives i.e. "learning by doing"
5. This method is more scientific if it is planned properly
6 The important objective of science teaching i.e "Power of observation" which lead to learning
7. This method help in achieving the learning outcome of teaching learning process
8 This method help teacher to pre-plan the activity related to project

Demerits of Project Method :

1. This method is considered to be a difficult method in importing instructions to the students.
2. This method need proper physical facilities in the school in the limited grant and facilities. This method can not be adopted in school.
3. Teachers are not trained to adopt this method of teaching. Therefore we cannot use in classroom teaching.
4. Text books are not helping bath teachers and students to adopt this teaching method/providing learning experiences.
5. This method can't be adopted for timebound syllabus.
6. Our system of evaluation is examination oriented and hence this method is not finding much weightage in classroom teaching.

Procedure :

1. **Planning** :- This is one of the important step after identifying the problem. In this process teacher and student both has to work properly i.e. different group persons are assigned different task. For eg. if one is good in library work he may be assigned to collect in relevant information from the library all reference material latest researches conducted on the problem be collected by the student.
2. The second member of group may be assigned to collect material from the laboratory or rom outside. A person who collects the material should know limitations of the laboratory (limitation in term to knowledge level)
3. Third member of group should try to perform experiment in the laboratory and should observe all normal observtions also abnormal observation The person who is performing experiment should also be up to date in experimental skills.
4. The fourth member of group will try to collect and orrange the obseration in tabular form in a report form.

Formultation of Hypothesis :

In order to formulate hypothesis all the members of group and teachers should sit together, inter act about the problem and should formulate 3 or 4 hypothesis.

Observation and data collection :

For this work the student are suposed to go laboratory. They should be given physical facilities by teacher and to perform the experiment

Interpretation of data :

This is a difficult task which should be done in collaboration of both teacher and student. Teacher should highlighted observation and observation should be written down in words. After this from the table it should be clear the exact reason of the problem.

Different types of examples for Project Method are as follows :

1. Foaming capasity of different soap.
2. Rusting of iron.
3. Study of the impurities present in different Water saircs using boiling water.

EXAMPLE - 1

Foaming Capacity of different soaps in different types of Water :

1. **Planning :-** To deal with this problem taking Project Method we devide the student A, B, C, D of group and each student is given particular activity to perform.

Student A is good in library work so he is assigned to collect relevant information from the library all reference material, latest research C class IX reference.

Student B is assigned to collect all the required material from lab or out side the lab.

Student C will perform the experiment in the laboratory. He will observe all the onormal and normal informations about this project.

Student D will collect the observations and note down in tabular forms

2. **Formulation of Hypothesis** ·

(I) High foaming capicity due to

(i) local soap + Tap Water

(ii) local soap + Distilled Water

(iii) Rin + Tap Water

(iv) Rin + Distilled Water

3. **Collection of Material** : Tap water, Distilled Water, ocal soap, rin, test tube, measuring cylinder (10ml) scale.

References :

Class VII Rajasthan Board Project Mehtod Book (Dr. Bharava)

4. **Data Collection and Observation** : Student will go to lab and will perform the experiment as shown in the figure - I (Note :- Take equal amount of Water in each test tube and add equal amount of soap in each test tube.

5. **Interpretation of Data** : On performing experiment we find that the foaming capacity of rin soap in distilled water is maximum than foaming capacity of rin soap in tap water. Aslo we saw that foaming capacity of local soap in distilled water is quite high than the foaming capacity of local soap in tap water. So we can say that foaming capacity of rin soap is maximum (3.5 Cm)in comparision to local soap (2.4 cm) in distilled water.

6. **Conclusion** : High Capacity of foaming (length of foam) is due to distilled water and rin soap.

EXAMPLE - 2

Rusting of Iron :

1. **Sensing of the Problem** :- There is old hut out side the R.I.E. College. The roof of hut is made up of iron. The outer surface of hut turned brown in colour. The inner portion of the hut is shining. Everyday student and teacher passed near the hut and observe the brown colour, teacher point out that this event why the upper portion of roof of hut has turned brown in colour. So teacher

give this project to a particular group of students and this project is mainly concerned about rusting of iron.

2. **Planning** :- To deal with this problem taking project method we divide the students A, B, C, D of group and each student is given a particular task for this prject

Student 'A' is good in library work so he is assigned to collect in relevant information from the library, all reference material, latest research C Class IX reference book.

Student 'B' is assigned to collect all the required material from lab or out side the lab.

Student 'C' will perform the experiment in the liboratory. He will observe all the abnormal and normal informations about this project.

Student 'D' will collect the observations and note it down in tabular form.

3. **Formulation of hypothesis** :- All the members of the group will sit together and will interact with each other about the problem i.e. rusting of iron andformulate hypothesis which are as follows :-

a) Rusting of iron due to air.

b) Rusting of iron due to hot air.

c) Rusting of iron due to cold air.

d) Rusting of iron is due to water and air (Moisture)

4. **Observation and data Collection** :- Student will go to lab and perform this experiment as shown in figure-2

5. **Interpretation of data** :-Student will interpretate the experimental observation that for a I and II day there is no difference on the III day some colour develop at the junction of 2 phase (H_2O + air) in beaker D and this colour is similer to that of brown colair which has been rusted student conclude th. rusting of iron is due to air and water both.

EXAMPLE - 3

Study of boiling point of different water resources with respect to distilled water :

1 **Planning :-** To deal with this problem taking project method we divide the student in four group i.e A, B, C, D Each will check the purity of water from one source. We have taken 4 sources of water which are easily available the samples are :-

Group A - Distilled Water

Group B - Tap Water

Group C - Hand pump Water

Group D - Rain Water

Before starling with experiment Group A is given the responsibility of collecting reference material. Two types of materials are required.

Collection of Material :

1. **References :-** Journals, text book of chemistry and practical book (Project book).
2. **Physical Material :-** Four beaker, 4 spirit lamp, 4 thermometers, 4 boiling tubes, distilled water, tap water, hand pump water and rain water.

2. **Formulation of hypothesis :**

1. The boiling point increses with addition of impurities.
2. The boiling point decreasing with addition of impurities.
3. There is not effect of impurity on boiling point

3. **Data Collection and observation :**

Student will go to lab and will perform the experiment as shown in figure-3

4. **Interpretation of data :**

On performing experiment we find that distilled water has boiling point at 100°C There is no impurity As we proceed with other sample we interpretate with other samples The boiling point decreases The lowest boiling point is of

hand pump water This shows that hand pump water has mximum impurities because of salts dissolved in ground water were is tap water with less impurities, as much of the impurities are removed before it is supplied by municipalities rain water is less impure and some of little impurities are due to reason when rain water reaches surface on its way some dust and gases are dissolved due to environment pollution

5. **Conclussion** So we can say that boiling point amount of impurities

EXAMPLE - 4

To investigate tha acidic character of the given fruits by pH paper :

1. **Planning** :- To deal with the problem taking project method we divide the students in 3 groups i.e. A, B, C. Each will check the character of fruits. We have taken 3 fruits (Orange, Mausani lemen) which are easily available.

The fruits are :

Student A - Unriped and Riped Orange.

Student B - Unriped and Riped Mausanie

Student C - Uriped and Riped Lemon.

Collection of Material :

1. **References** :- Journal, test book of Chemistry and practical book (Project Book)
2. **Physical Material** :- Lemon, Mausanie, Orange, Distilled Water, Beaker, p^H paper.

Formultaion of hypothesis :

1. Riped fruits have less p^H value.
2. Unriped fruits have less p^H Value.
3. The Unripe lemon is more acedic that of riped lemon
4. Unriped fruits will have maximum p^H.

Data Collection and Observations :

Students will go to market and will purchaes riped and unriped lemon, mausani, and Orange and then in lab will perform exp as shown

Method ·

1. First student prepare juices of all the varieties of given fruit by meshing.
2. Taking 10CC of each fruit juice with the help of pipette
3. p^H or universal indicator used for measuring p^H

Interpretation of data

On performing experiment we find that.

1. p^H of riped fruits have more p^H in comparision to unriped fruits
2. p^H of ripted mausami have highest value among given fruits.
3. p^H of riped lemon is least among given fruits.

Conclusion :

From this we can conclude that lemon has maximum acid content or least P^H value in comparision to other fruits

$$p^H \propto \frac{1}{\text{acidic content}}$$

Planning :

Tacher will ask the students to observe their surroundings. What is necessary constituent for our respiration ? Student will reply that O_2 is necessary. From where we get the O_2? Students reply from plants. For plants which gas is necessary for their respiration. Student reply that is Co_2. Now teacher will tell the intrdependence of plants and animals.

Formulation of Hypothesis :

Students will make the statement or think about that how animals and plants are depend upon each other for their survival.

1. Animals depend upon plants for their food.
2. Some animals depend on plants for sheltor
3. Animals and plants depend on each other for respiration

Collection of Materials :

Plant, One insect i.e grasshopper Beljar

Testing of Hypothesis :

Teacher will perform the experiment in the laboratory with the help of students

Firstly we take the plant and cover it with jar

Secondly we cover the insect in air tight jar

Thirdly we will keep the pland and insect under one covered jar

Sl. No	No of Hours	Position of Plant and Insect		
		Plant Covered	Insect Covered	Both Covered
1	First	No Change	No Change	No Change
2	Second	No Change	die	No Change
3	Third	Planot, leaves collapse	die	No Change
4	Fourth	die	die	Survive

Interpretation :

While observing above data. We came to know that alone plants and animals can not survive but where planet and animals kept together they survive. Because CO_2 exhaled by insect is utilized by plant and O_2 exhaled by plant is utilized by insect. So they are depend upon each other for their survival.

Conclusion :

We can conclude from the data collection that the plant and animals are depend on each other for their survival.

Topic :- To study the Calorific value of different typle of fuels :

Planning :

Teacher will ask the students that when we feel cold how you keep you self warm. From where you get heat. The reply of the students that y burning of wood, Gross some oils or some papers ect Now teacher will ask them from where (Material) we can get more heat

Formulation of Hypathesis .

When teacher talk about the amount of heat given out by burning of

different material students also think that Ground nut oil produces more heat than mustard oil or kerosene produces more amount of than coconut oil. This type of thinking in the mind brings comperision of different material that how much amount of heat is produced by burning the sameamount of material.

Collection of Material :

Ground nut oil, petrol, kerosene and spirit, Beaker, thermameter, Water, Tripod stand strirror and calorimeter ect

Testing of Hyp thesis :

Teacher will now perform the experiment with different oils is coconut, ground nut mustard and kerosene oil He assist the students in experimentation.

He takes equal amount of all the oils is coconut, Kerosene mustard and ground nut oil and heat the same amount of water and in each case records the temperature every time.

Interpretation :

While observing temperature of all the liquids there is variation in their temp.

Conclusion :

We can conclude from the data that different liquid produce different amount of heat if same amount of the liquid is burnt under similar conditions. The sprit has the maximum calorific value amongst the four liquids taken for experimentation.

STRATEGIES OF TEACHING

The main objective of teaching is to bring about a desirable change in the behaviour of the learner It is brought about by the teacher using teaching strategies to achieve his objectives

The teaching is much more difficult task It requires different types of methods techniques and teaching aids The selection of these methods and technique depend upon the nature of task- Learning objectives learner-abilities and student's entering behaviour

The learning objectives and task analysis provide the basis for effective presentation of teaching In order to bring desirable change in the behaviour of the learner, teacher has to employ the proper teaching strategies

Meaning and Definition of Teaching Strategies:

In order to understand the meaning of teaching strategy We must understand the term strategy

According to Laurence Ur-dangstrategy means – a plan, a method or series of stratagems for obtaining a specification goal or result The science or art of planning and directing large military movements and operations

The use or an instance of using this science or art

The skillful use of strategies

According to B O Smith – The term strategic refers to pattern of act that serves to attain certain outcomes and to grand against certain others

According to Stones and Marris - Teaching strategies is a generalized plan for a lesson which includes structure desired learner behaviour in terms of goals of instructions and outline of planned tactics necessary to implements the strategy the lesson structure is a part of a larger development scheme

From the definition it is clear that teaching strategy involve two aspects

i) A generalized plan for the presentation of a lesson and
ii) It includes desired learner behaviour in terms of goals of instruction

Teaching strategy seeks to establish the relationship between teaching and learning in view of achieving the objectives

Teaching strategies include broad method of instruction a lecture strategy, a tutorial strategy, Demonstration strategy, discussion strategy, discovery strategy

Characteristics of Teaching Strategies:

Stones and Morris describe the characteristics – Teaching tactics Tactics is goal linked influenced or influencing behaviour of the teacher, the way he behaves in the instructional situation in working towards the development of the strategy Unit of teacher behaviour through which the development of the strategy Unit of teacher behaviour through which the teacher fulfils his various instruction role which the students of his class from movement to movement the component of the teacher behaviour through which the teacher the student and the subject matter interact

In this way teaching strategy play an important role in organization of teaching activities Following are characteristics

1) **Referring to Teaching Act:**

Teaching strategy direct the teaching working towards some model This hint is to obtain object outcomes and unwanted outcomes are rejected

2) **Helping the behaviour modification**

Teaching strategy is helpful to achieve the goal of behaviour modification

3) **Task analysis**

Teaching strategy help in analyzing teaching activities and more importance is given to its structure This is an important unit of organization of teaching activity

4) **Loyal work**

Teaching strategy help in knowing the awareness of teaching work

5) **Development in efficiency**

One of the important principle of teaching strategy that 'work is worship' whatsoever work is done it is done with good faith.

Teaching strategy help in clear thinking, self-study and personal growth

Types of teaching strategy

A teacher organizes his activities of teaching to bring about the desirable change in the behaviour of the learner Thus the students are forced to achieve learning objectives Most of the teaching strategies are selected to be used by students with their full capacity They attempt to achieve maximum students performance Therefore, it is essential to known about different teaching strategies in terms of their effectiveness in achieving different kinds of learning objectives These are the means for realizing the learning objectives Teaching strategies are classified in two classes

(a) Automatic style (b) Permissive style

(a) Automatic Style

It involves the following strategies

(a) Lecture
(b) Lesson Demostration
(c) tutorials
(d) Programmed instruction

(b) Permissive Style

It include the following strategies

(a) Heuristic
(b) Project strategy
(c) Group discussion
(d) Enquiry strategy
(e) Problem solving
(f) Computer Assisted instruction
(g) Brain storming
(h) Assignment strategy

Autocratic style of teaching strategies:

The autocratic styles strategies are content centred and teach remains more active and student remains passive list ness The autocratic teaching strategies realise cognitive objective while permissive teaching strategies tend to achieve affective objectives

1. Lecture Strategy

The lecture method is the most widely used instructional strategy at all stages of education This method is most dominating method today and is liked by majority of the teachers The teacher is only the active participant in the teaching learning process and the pupils are the passive listeners with the result that students take no interest in learning and at time they feel bored The lecture is often considered as a communication strategy Lecture can be used to realise the highest order of cognitive objectives

The lecture is an exploration of knowledge, facts, principles or other information, which a teacher wishes to present to his pupils While using strategy the teacher assumes that students possess sufficient background and ability to understand the lecture the key steps of this strategy are

Intention → Transmission → Receipting information

The purpose of lecture strategy is to motivate, to clarify, to review and to expand This is also useful for the following

1 To convey information of the subject
2 To generate understanding of the subject
3 To stimulate interest about subject

Use of Lecture Strategy:

In using the lecture method there is a need of proper planning and effective execution so that it can generate learning, which is as follows

1) A lecture should take into account the knowledge, which the students have previously acquired and its relationship should be established with the new topic to be discussed by the teacher
2) The lecture should be well planned It should be in simple language to meet the requirement of the students
3) The lecture should include some examples to motivate the students
4) The subject content should be correlated with other subjects
5) The teacher should give conceptual framework for the new material to link it with previously learned ideas
6) There should be lecture-question session that will help the students to clarify key concepts

Advantage of Lecture Method:

1) It is economical because new laboratory apparatus, aids etc are required A single teacher can teach as many students as he can
2) It simplifies the work of teacher Teacher has to put less labour to prepare his lesson
3) It is useful in imparting factual information and relating some of the thrilling historical and biological incidents in science

1. Limitation of Lecture Strategy

Following are the limitations lecture strategy

1) This is unpsychological This does not touch affective and psychomotor activity during teaching learning process
2) It does not provide for inculcating scientific attitude among the students
3) A low level lecture does not motivate the student for learning
4) Rate of imparting information by the teacher may be high which does not suit the requirement of the students

2. Demonstration Strategy

This is a traditional classroom strategy, which is mostly used by teacher educations during teaching practice Science is based on sensory experience and in learning by observation and experimentation a student uses his sensory organs

Purposes of demonstration

1) To provide learning experience through display of objects
2) To develop power of observation
3) To verify facts and principles through demonstration activities
4) To give training for developing proper skills through observation of some demonstration

Planning a Demonstration

In planning a demonstration teacher should determine the need and importance/relevance He should relate the objectives with the demonstration Teacher

should collect all the material through which he is going to have demonstration activities Teacher should arrange the material in the order of demonstration Teacher should be clear of the purpose of demonstration Teacher should try out the demonstration activities Teacher should plan demonstration in such a way so that interest may develop in teaching learning process

Advantage of Demonstration Strategy

1) It is economical as it saves both time and money
2) It is psychologically bases the students are shown the concrete things
3) This is useful when the instruments are costly

Limitations of Demonstration Strategy

It suffers from the following limitations

1) It does not provide an opportunity to develop originality to pupil teachers They try to imitate the model lesson in their teaching
2) Teacher education cannot demonstrate the activities correctly and affectively

B. Permissive Style of Teaching Strategies

This strategy is based upon "modern theory of generalization of task and relationship centred" It is mainly child centred, content is largely determined by the pupils In this strategy both students and teacher remain active in teaching learning process These strategies encourage the creativity of the pupils, which are as follows

C. Heuristics Strategy:

Science is not a thing to be talked about but a practical subject and the correct way to learn is by doing

This method of teaching ensures the use and development of the sense of touch, sight and hearing The basic idea of this strategy is that the student should discover everything he learns about from his own observation and experiments

Heuristic strategy is a technique of teaching which involve our placing the students as far as possible in the attitude of a discover This strategy develops self-activity and self-dependence among the student, which help in developing scientific attitude

Purpose of Heuristic Strategy

1 To make pupils more exact, more truthful, observant, thoughtful, dexterous, to lay the solid foundation for future self-education
2 To encourage the growth of a spirit of enquiry
3 To develop scientific attitude among the students
4 To motivate the student for learning
5 To make teaching learning more objective

Steps of Heuristic Strategy

A problem is assigned to the class and students are made to feel responsible for finding out the solution by himself Each student is allowed to think over the problem in own way The students can get a bit of guidance from the teacher students are allowed to formulate their hypothesis and teacher should help in testing them They collect data, interpret the data, formulate the tentative solutions and then arrive at desired conclusion

Teacher should be man of knowledge to give reference He should adopt the art of questioning and should encourage the students to ask questions He should be the guide a working partner and a friend of pupils He should provide an atmosphere of freedom in the classroom in order to encourage self-development

Limitation of Heuristic Strategy

1) It is too much to expect children to discover everything themselves
2) It is a slow process and hence time bound syllabus cannot be cover
3) This method is foundational rather than informational
4) This method needs less number of students in the class
5) It is not economical required more apparatus and equipment

This strategy consists of building a comprehensive unit around an activity, which may be carried on with school or outside The essence of this strategy is to carry out a useful task in a group in which all the students work cooperatively Project is a purposeful act of doing work It is whole-hearted purposeful activity proceeding in a social environment

Purpose of Project Strategy

1) To inculcate scientific attitude
2) To solve problem in scientific manner
3) To motivate the students towards scientific activities

Steps in developing a Project

There are four major steps in developing a project

1. Providing a Situation

The teacher should provide such situation to the students, which may create some problem for them

2. Choosing and Purposing

The children should be tempted to choose a project The teacher should stimulate discussion by suggestion The purpose of the project should be clearly defined and well understood by the pupils

3. Planning

Planning in a project is very important for the success of a project depends upon good planning The students should plan out the whole scheme under the guidance of the teacher planning involved searching the most appropriate and viable line of action from the various available ones

4. Executing

The teacher should assign duties and distribute work among the pupils of a group according to their interest and abilities Every child should contribute activity towards the execution of the project A single project promotes great many activities of knowledge The teacher should guide, encourage and watch the progress of students and should give instructions wherever needed

5. Evaluating

Evaluation from time to time is essential The evaluation procedure is related to the nature of the activity

6. Recording

Students keep a complete record of work in a proper form

Advantage of Project strategy

1) This strategy help in development of scientific attitude among the students
2) Students plan execute and evaluate their own work
3) Students get an opportunity to do some activity in its natural environment
4) Students learn in real and social setup
5) Pupils learn how to organise work for themselves and to accept responsibility

Limitation of Project Strategy

1) Project work takes more time and it is time consuming
2) It needs proper material for execution
3) Time bound syllabus cannot be completed in time

Group Discussion Strategy

The group discussion strategy is considered as a democratic teaching strategy In this method student are more active Teacher's role is to supervise and to provide guidance to pupils' activities This strategy is considered as child centred teaching The group discussion strategy may be divided into two forms

I By the Teacher – This type of discussion is more autocratic in style

Inquiry strategy

In inquiry strategy student is put in attitude of researcher Teaching learning process take place by taking unknown problem by the students

Inquiry or discovery refers to a process of self-learning by taking unknown problem

Purpose of Inquiry Strategy

1) To develop the habit of doing work in a scientific manner
2) To test and verify the tentative hypothesis frame by the students

Step involve in inquiry strategy

1) Selection of problem
2) Collection of material
3) Formulation of hypothesis
4) To conduct experiments
5) To collect data
6) To analyse data
7) To draw conclusion
8) To write a report

Principle

1) Freedom to the learner
2) Providing a responsive environment
3) Advised guidance of science teacher
4) Encouragement to cognitive learning through discovery

Advantages

There are many advantages of inquiry method, which are as follows

1) Inquiry approach increases intellectual potency of the learner
2) Inquiry approach is bases an intrinsic motivation rather extrinsic motivation
3) Student develops the ability to sense the relevance of variables Students learn to organise and conduct investigation
4) This method develops a better way in memory retention
5) It increases the achievements of learner.
6) This method increases manifold talents in the learners in addition to the academic one

Limitation of inquiry strategy:

Following are the limitations of this method

1) Teachers are not trained to adopt this method
2) Students are not used to take learning experience through this method

3) Textbooks are not written to adopt this method of teaching
4) Discovery learning takes more time than receptive learning

Problem solving Strategy

Problem solving may be defined as a planned attack upon a difficulty or perplexity for the purpose of finding a satisfactory solution This involves the process of reflective thinking It is a process of reasoning a problem in the minds of the students in such a way as to stimulate purposeful reflective thinking in arising at a rational solution

Problem solving involves concept formation and discovery learning as a part of problem solving

Steps of Problem Solving Strategy

Following are the steps involve in problem solving methods

1. Identifying and Defining the Problem

The teacher should provide such situation in which the student feels the need of asking some questions The teacher may also put some questions, which develop reflective thinking, which become the part of a problem to think

The students now define their problem in a concise, definite and clear language There should be some key words in the statement of the problem, which may help in better understanding the problem In other words they should get an exact idea about the problem and should define it in clear terms

Formulating Hypothesis

In order to focus on the problem students should identify the purpose for which the problem has been undertaken The investigation should hypothesis the relationship between two or more variables or differences between two or more treatment A review of previous experiences/research in this area may suggest several possible causes of this problem These possible causes may be stated as hypothesis

Testing Hypothesis/collecting evidences

The investigation should conduct the experiment or should try to study the observations made or should gather data based on his experiments

Interpreting the Data

Interpretation of data should be based on proper use of techniques and it can be recorded through charts, graphs, table etc

Drawing Conclusion

Conclusions of the results drawn on the basis of data should be accurately reported after proper interpretation Such conclusion will be considered valid and useful Findings should be reported concisely and suggestions for further work should be mentioned

Advantage of Problem Solving

1) Problem solving approach is an attitude building process, which helps a person to be logical and systematic
2) Problem solving helps the students to acquire critical thinking abilities.
3) It help in developing skill of conducting experiment and recording observation
4) Problem solving develops a mental attitude for effective and reflective thinking

Limitation of Problem Solving

1) Teachers are not trained to adopt this method to provide instruction by this method
2) Science books are not written to adopt to get learning experiences

Computer Assisted Strategy

The National Policy of Education (1986) has laid emphasis on the use of computers in teaching learning of the school The use of computers has also influenced the educational process Now a days it is used effectively for imparting more information and facts to the students according to their interest and abilities

Purpose of Computer Assisted Strategy

1) To teach science subject according to the need and interest of the students
2) To solve the personal problem by adopting informal system
3) To meet the requirement of individual difference among the class
4) To provide better instruction to gifted students.

Role of Teacher in Computer Assisted Strategy

In order to effective use of computer in classroom teaching, teacher should have the following competencies

1) Teacher should know the code of the computer
2) Working knowledge of computer literacy course
3) Competencies in use of computer and should able to demonstrate to small group
4) Use of computer terminology as it relates to hardware
5) Ability to select suitable software for the students to meet their requirements
6) Knowledge of design of educational software, Computer in scientific subjects
7) Ability to locate and procure information on computing as it related to education

Advantage

It has the following advantage

1) It is highly individualized teaching and instruction on the same topic different type of programme may be provide to different types of students
2) It can be effectively used for achieving cognitive objectives

3) It is based on psychological principles of learning
4) It provides immediate reinforcement to each correct response of the learners

Brain Storming Strategy

It is completely permissive style of teaching strategy It is based on the fact that better learning can take place when the student is given chance in a group rather than individual

This is problem-oriented strategy of teaching

Steps of Brain Storming Strategy

1) Plan all the different phases of the problem and think about the internal phases
2) Arrange all the sub-problem in the particular order
3) Discuss the problem, logical and collect the data based on certain facts
4) Select the most possible idea of the solution of problem
5) Consider the various possible ways to solve the problem
6) Take decision about the final solution of problem

Advantages

This strategy has the following advantages

1) This is based on psychological principle of learning
2) It is more creative strategy
3) It provides more ideas of good quality
4) It creates the situation for more independent thinking among learners

Assignment Strategy

Assignment strategy is the embroilment of elective, demonstration method and the individual laboratory work by the students

The whole of the course is divided into number of well-connected portion to be covered in the week or so and are called assignments.

Assignments are classified into two classes

1) Home Assignments
2) School Assignments

Basic nature is same, the school assignment is to be completed in a limited time under the supervision of the teacher where as home assignment is completed by the student at their home

Purpose of Assignment

1) To achieve the objective of teaching learning
2) To develop scientific attitude among the students
3) To develop interest among the students about the subject
4) To develop creative ideas among the student to write the answer of the problems

Advantages

It has the following advantages in teaching science

1) It helps in developing good reading habits
2) It meets the individual interest and individual learning
3) Student learns according to his own experience
4) It helps in reviewing the learning experience by the students and teacher both

Values and Teaching Strategies:

Value is something that is chosen from alternative and is acted upon and enhances creative integration and development of the human personality For a value, one has to make free choices from alternative, many options must be there

A value is the stance that the self takes to the total environment as expressed through its behaviour, ideas, body feelings and imagination Values are abstract ideas, positive or negative, not tied, if any specific object or situation, representing person's beliefs about modes of conduct and ideal terminal states National Curriculum Framework for school Education (Nov 2000) has also stress that value education and education about religious would not from a separate subject of study at any stage These would be so judiciously integrate with all subjects through different teaching strategies

Teachers sho uld use brain storming for value clarification Different teaching strategies can inculcate the following value among the students

1) Awareness
2) Identification/Exploitation
3) Clarification
4) Erosion
5) Reinforcement
6) Cooperation
7) Cleanliness
8) Dignity and the individual
9) Dignity of manual work
10) Discipline
11) Friendship
12) Faithfulness
13) Self-confidence
14) Team work
15) Tolerances
16) Universal truth

MULTIMEDIA AND ITS APPLICATIONS

Dr. S. K. Pardkar
Reader in Physics

Multimedia computerized method of presenting information by combining audio and video components using text, sound and graphics for developing the effective and easily understandable information Today multimedia users comes from different walk of life Although multimedia is not a single entity but it is a combination of hardware, software and storage elements needed to develop and pay presentations Multimedia technology thus attempts a real time integration of various media and computer data for enhanced man machine interaction encompassing the audio visual senses In future, multimedia will pay an important role in the information technology by supporting many types and facilities of information for acquisition, transfer, manipulation, storage and retrieval Some of the broad uses of multimedia are multimedia conferencing video mail, office management, business applications, modeling, simulation, teaching and training, entertainment, publishing, high speed networking, health care, virtual reality – a buzzword for interactive 'real world type learning'

WHAT IS MULTIMEDIA?

The term multimedia is formed by the combination of two word multi and medium Multi refers to many i e more than one and media is the plural form of medium However, a linear dissemination of knowledge e g a television – a multimedia kit may not foot the bill but interactive multimedia with the help of computer which integrate many peripherals containing information resources is a sure way to effective learning with proved cost effective technology, the use of multimedia is growing rapidly in a wide area of business applications, including training, desktop video conferencing, customer service support presentation materials and 3D design systems

Multimedia actually encompasses two aspects of technology

- Capability to present multimedia format within an application
- The enhancement of the user interface

MULTIMEDIA

The synchronized presentation of any combinations of video, sound, Graphics, Text, images and animation on a computer in a flexible interactive way is known as multimedia

This implies that the world of multimedia is many medus a put together and is a team work to achieve object oriented tasks

One among various applications of multimedia is its use in physics education The imagination and observation part of physics along with analysis and simulation is many fold enhanced by multimedia

Enable to produce 30 pictures of crystal structures, which are otherwise to be imagined

MULTIMEDIA: What is multimedia?

Innovations in digital signals processing, mass storage and optical communication networks have enabled the integration of diverse type of media such as text, audio, video and graphics to be utilised in digital form This integration is commonly referred to as

MULTIMEDIA

A system with the capability to capture, digitize, compress, store, retrieve, decompress and present multimedia information is called a multimedia system Figure/illustrates the main functional blocks of a simple multimedia systems Examples of multimedia systems include distance learning, home shopping, video on demand, video conferencing and information kiosks.

Digital camera Video compressor Synchroniser Video audio
Video
Store

Microphone Audio digitizer Audio compresser

Storage Decompressor Synchroniser Video Monitor
Audio

USING COMPUTERS IN TEACHING PHYSICS

S.K.PARADKAR
RIE AJMER

'Computers can revolutionise not only the way we teach physics but also what physics we teach'

The computer has revolutionised the way we do physics, but surprisingly, it has not significantly altered the way we teach physics Talks and papers on teaching with computers fills the meetings and journals of the American Associations of Physics teachers, and the workshops on the topic aound Yet the real impact of computers in the classroom is slight

* Computers failing as teaching AIDS' The reasons the journal cited for this failure at the general pre college education level apply equally well to physics teaching at the Introductory college level
* Lack of access to computers
* Prior software and faculty members who are inadequately prepare to use computers effectively

In spite of dramatic advances in capabilities, decreased costs, extensive Familiarisation programs and widespread availability, computers are still not in regular use in physics teaching Part of the problem is that we are chasing a rapidly moving target The goals of access, software and faculty familiarity are difficult to achieve because our ambitions are so much greater today than they were decades ago

Still many wish to see the computer used more at all levels of physics instructions

Not only are physicists rethinking the role of computer instructions they are re-evaluating the very content of physics courses NCERT is studying the physics curriculum to determine how it might change to reflect physics as it is done today. As such studies bring up to date not only the topics to be taught but also the student skills to be developed in the introductory courses, computers may find a natural niche as both a mathematical and a pedagogical tool Alongwith the subject matter of physics, the methods of doing physics have changed greatly in recent years Numerical approaches to problem solving are wsidely prevalent in research but are rarely taught to beginning students. Computers may allow us to introduce these approaches earlier

We feel that computers can help us to emphasie fundamental physics, include more contemporary physics, train student intuition, provide student more experience with complex systems and given them some research experience

Computers have been put to a variety of uses on teaching physics Among these are

- drill and practice
- testing
- course management
- tutorials
- dialogue and artificial intelligence
- simulation
- instructional games
- laboratory data acquisition
- programming
- modeling physical phenomena

A variety of software has been developed to serve these purposes Physics instructional software is regularly reviewed by an evaluation project Some of these reviedws appear in a monthly column on **PHYSICS TEACHER'.**

Each of these ways of using computers can contribute to learning, but the educational context of the use determines just how effective a particular tool can be

Drill and practice, testing and course management are relatively straight forward uses of the computers that many physicists find practical but uninspiring Each can should be part of a physics instructional program, but they represent incremental improvements over traditional methods, not tools for reconstructing pedagogical approaches or altering course content

TUTORIALS

When physicists who are not involved in using computers to teach think of doing so, they often think first of tutorial programs Tutorial material have not received much acceptance in the physics community, and many question the educational philosophy behind tutorials, which are often characterised as 'computers running students'

To produce tutorial materials one must have a model of how students think and must recognise the preconceptions students brings with them into the classroom

Bork developed an extra ordinarily sophisticated system for producing tutorials that involved experts in cognition, physics teaching, design and programming but inspite of his best efforts few universities have adopted either his materials or his methods

ARTIFICIAL INTELLIGENCE

Artificial intelligence techniques and expert systems are the beginning to be used in Physics, but are little used in Physics education The solar system, a generalized artificial intelligence interface machine developed by Allen Newell of Carnegie Mellon, looks particularly promising, but has thus far not been applied to teaching

SIMULATIONS

The development of simulations that can be used as lecture demonstrations has been increasingly popular in the past few years Many institutions now have video projection systems that allow entire classes to follow graphic demonstrations, the systems represent great improvements over the lectures drawing skills In the coming years we expect that more good materials will become available and that computers will be routinely used for visualisation in lectures

Students can also use simulations directly to explore the structure of physical model Taylor has produced 'space time physics' a tool that takes students into the world of special relativity **'The ultimate Einstine'** and **'The Brief history of Time' Stephan Hawkings** is now available in CD ROM Version, which gives some simulations. In the field of electronics also **'Circuit maker' shareware** require no electronic components You can make your own circuit by selecting dragging, dropping electronic components

Like wise **'TINA' a software available in India** on the circuit simulation

Each of these programs is accompanied by curriculum material to be used in the classroom. These special programs help students build intuition

The computer is not a tool in search of a problem It is better to start with a problem and then seek a tool than vice versa

Any of the thousands of graduate students teaching labs each year can identify common problems students come ill prepared for the laboratory They do not read through the materials a head of time. Laboratories are considered boring The student try to fit too much work in too little time The objectives are rarely well understood Students cannot make the equipment work properly They rely on their partners to do work, and they leave the lab with little understanding of what happened In an attempt to remedy these problem the laboratory instruction give lengthy and detailed prelaboratory instructions that compound the time problems and seem to do little for students understanding

A number of technological solutions to these problems have been attempted, with varying success. These include videotaped prelaboratory preparations, self paced laboratories and computer controlled video disc pre laboratories Each of these solutions has its own problems The video taped prelaboratories are totally non interactive, and lead to a cookbook approach to the laboratory Although video discs can be much more interactive, the interaction paths are few and must be decided a head of time by the producer The open and self paced laboratories require expensive facilities and a well managed system to cope with the complexity

One approach to these problems involves the use of simulations as a required prelaboratory activity 'Circuit maker' 'Oscilloscope'

COMPUTER DATA ACQUISITION

Computer data acquisition can also be used to improve lab experiences, but one must be careful to ensure that the computer does not become a 'black box' that obscures rather that enlightens

Programming and modeling were among the earliest uses of computers in physics education and yet they remain largely unexploited and potentially powerful tools Physics students have been expected to program and develop computer models as they advance through the major, but courses at the introductory level have rarely included such work

Is computer Appropriate for teaching universe?

The answer is yes, the computer can help your students to learn physics – but not in all cases and not in general The crucial question is what physics to which students Denn is Donnely says in the article describing "If software developers should get their products into the hands of potential users and watch in silence, they would learn much valuable information" That is good start If softer ware developers asked users what they thought was happening in the program and what they were learning and their listen carefully to the responses, they would take a lens step forward of developing computer software's that would actually promote learning

LEARNING PHYSICS WITH COMPUTERS

List of main types of use

* Awareness Allowing the learners to gain familiarity with the system
* Computer Studies Learning about the computer and its uses as a subject of study in its own right, rather than as a tool in other curricular areas
* Management and Administration – The computer as a tool for background departmental work
* Using business software – word processing and such like
* Computer aided learning – where system add to other learning resources
* Control Using computer to log data from its environment and to control other equipment

The most important types of business software for physics departments handle word processing, graphics (picture processing) data base work (information storage and access), communications (information transfer), and the use of spread sheets (table processing)

Word processing Preparing worksheets, handouts, notes, question banks, stock lists and notices

Learners: Producing essays and other assignments, projects, and experiment reports

Graphics: There are two types f graphics packages The business grahics software that produces a range of histograms, line graphs and pie charts from data set and may also offer statistical analysis features, and the 'artists' programs that can give prints out of beautiful diagrams (free hand or line, like those of apparatus, flow charts and circuits)

Staff: Graphing many relationships in theory and practice contexts, producing quality illustrations for overhead projection, notices or distribution, showing expenditure and assessment breakdowns clearly

Learners: Graphing experimental results, producing quality illustrations for projects, assignments and reports

Processes pictures and processed words commonly support each other, the current need, in combining them for fidding with hardware and software and will be assuaged soon enough by use of desktop publishing systems These allow the user to process pages of materials a whole, as well as the individual chunks of text and graphics that makes up the pages

Database: Such software provides the electronic equivalent of card and simple paper files Applications depends greatly on the flexibility of the program used

Staff: Students records, orders, suppliers and stock records, reference files, glossaries and questions banks, practical class registers

Learners: Reference and revision notes, glossaries
Communications

COMPUTER ASSISTED LEARNING

Learning with the aid of computers rather than learning about computers

CAL CA Training CML supporting

Distribution might also be made between computer Assisted learning (CAL) and computer assisted Training (CAT) on the grounds that the aim and methods of training are rather different from those of education However both are concerned with learning and in practice there are more similarities than differences between the two Most of the knowledge and skills of CAL are equally appropriate in training

assessment routing record keeping reporting functions more intimate intervention in the learning process itself.

Fundamentally, all the computers do, whether they are used for scientific calculations, weather forecasting, banking or training, is to process information by moving it from place to place, combining it, and comparing according to a set of prespecified rules called a 'program'

Computer assisted learning is therefore, is concerned with the use of computer to mediate in the flow of information in the learning process. These may be the flow between the learner and the factual information that he or she must absorb, feedback from the learner on his or her progress.

The process of learning is typically supported by a variety of media to provide information and to help the learner to organise his or her growing knowledge Each different medium has its own strengths and weaknesses so media are selected to match specific learning problems and blended so that the weaknesses on one are overcome by the strengths of another

The main strength of the computer as a learning medium is its ability to process information very quickly and accurately. The set of rules the computer program, which specifies the way in which the information is to be manipulated can be very complex, yet the processing can be completed so quickly as to appear almost instantaneously to the learner This makes it possible for the computer to accept and act upon a variety of different kinds of response from the learner and to provide information in textual, graphical, and animated form (Multimedia) The computer can control and coordinate information from other pieces of equipment, for example a slide projector or video disc player, and based on the learners progress through a piece of structured material, it can make sophisticated decisions as to what course to follow next

This gives it ability to adopt and respond to the learners' needs, difficulties, and progress which is very much greater than that of a book or video tape, but which is still less than that of a real tutor Although it may be less impersonal than tape/slide, it should not be regarded as a substitute for another human being

Its weakness arises from its technology The real cost of computing equipment continues to fall, it continues to get smaller and more sophisticated, but it will still be some time before a really cheap, fully intelligent, pocket size, ubiquitous CAL system is developed

What do our students and how do they respond to what we teach them? Two guiding principles that designers of educational computer materials should keep in minds are

Students are not blank slates What they learn depends strongly on what they know or think they know Students learn bet through active engagement but "hands on" activities are not enough, it must be "brains on" as well

I classify computer activities designed to promote learning as being of two types Constructive and Video game The former helps the student understand through active mental engagement In the latter, students learn by "Calibration" They do something and see what happens Though some learning takes place, it is not he conscious, precise, and insight ful kind and that we need in physics

By now there are a number of excellent constructive computer applications in teaching-learning of some abstract topics in Astronomy, Astrophysics, Universe, Cosmas --- etc (list enclosed)

Multimedia CD Titles on Universe & Solar System

1	Eyewitness Encyclopedia of space & universe	D K
2	Touch the sky and Touch the universe	Britanica
3	A Brief History of time	Stefen's Hawking
4	Red Shift 3	
5	Planetarium Gold V 2	
6	Earth lab 2000	
7	Satellite 2000 Sc Lab	
8	Nine worlds	Petricks steweart
		Voyage through solar system
9	Our solar system & beyond CD – Titles	
10	Allas of our solar system	
11	Beyond planet Earth	Discovery CD-RoM
12	The universe	Zane Home Liberty
13	History of universe	
14	Guide of universe	Petrick Moore's.
15	Universe	Discovery
16	Explore space	Delux Psack S CD's
	(a0 Solar system	
	(b) Mars	
	(c) The Sun and the Moon	
	(d) The Galaxy	
17	Interactive cosmos	2 CD's pack
18	Solar system	Discovery
19	Space Exploration	Discovery
20	The Interactive space Encyclopedia	Focus (knowledge)
21	Astronomy 2000	The ultimate Astronomy and graphics & Software collection
22	Pro-one Astronomy	10 out of 10
23	Discover astronomy	Knowledge (focus)
24	Astronomer	Expert

25	Journey to the Planets	Multimedia
26	Our Solar system	Chestnut
27	Eyewitness D K Encyclopedia of space and the universe	D K multimedia
28	Discovery	Magnetism
29	Discovery	Nuclear Energy
30	Discovery	Sound
31	Force and Gravity	Discovery
32	Electricity	Discovery
33	Light	Discovery

Source

Cultural Book Depot
331-A Lamington Road
Opp. Police station (grant Road)
Mumbai-400007.
Tele: 23855172; Tele fax- 23876392
Email: compcult@satyam.net.in

Evaluation and Grading

A B Saxena

- Examination and Evaluation
  - Difference
  - examples

- Types of evaluation
  - Summative evaluation
  - Formative evaluation
  - Self-referenced, criterion referenced and non-referenced

- Shortcomings of present evaluation system
  - Lacks reliability and validity
  - Focuses on cognitive areas and ignores non-cognitive areas
  - Emphasis on memorization
  - Avoids applications, creative thinking, inferring etc.
  - Too much emphasis on summative written test; leads to stress.
  - Diagnosis and remediation are seldom employed
  - Rigid, lacks flexibility and multiple evaluation techniques

- Evaluation system could be further improved by
  - Trusting teachers
  - Carrying out continuously and comprehensively
  - Using alternative procedures and techniques
  - Using modern technology
  - Making it humane
  - Using grades in place of scores at certain places
  - Introduction of semester system

- Evaluation at primary stage
  - Formative evaluation is of much importance
  - Observation and oral method rather written in early years of schooling
  - Co-scholastic areas are very important
  - Criterion-referenced tests to be used periodically for assessing competencies to the mastery level
  - Three point absolute grading in scholastic areas and three point direct grading in co-scholastic areas.
  - Informal evaluation is important.

- Upper Primary Stage
  - Apart from oral and written tests, assignments and project work would also be used
  - Criterion referenced tests to be employed periodically to ensure competencies at mastery level.
  - Self-evaluation and peer group evaluation may also be part of total evaluation.
  - Five point absolute grading in scholastic areas and three point direct grading in co-scholastic areas.

- Secondary Stage

    - No pass or fail: evaluation in different areas using nine point absolute grading. Emphasis on continuous and comprehensive evaluation: diagnosis and remediation
    - Assessment by criterion reference tests
    - Assessment in co-scholastic areas using observation, checklists, rating scales and on five point direct grading.
    - Individual portfolios to be maintained

- National Evaluation Organisation

    - Need
        (a) Multiple boards with varied standards
        (b) Large number of entrance tests

    - Purpose
        (a) Quality control
        (b) Nation wide tests on voluntary basis

- Grading

    - Grading is used to minimize some of the shortcomings of the present evaluation system that involves awarding of numerical scores

    - There are two types of grading systems
        (a) Direct grading
        (b) Indirect grading

    - Indirect grading could be
        (i) Absolute grading and
        (ii) Relative grading. Examples are

- Absolute grading

Scores	Grade
75% and above	A
60 % to less than 75%	B
45 % to less than 60%	C
33 % to less than 45%	D
20 % to less than 33%	E
Below 20 %	F

Relative grading (Nine point scale)

S.No.	Letter of Grade	Interval	No of Cases	Grade Value
1	A	1.75σ to ∞	4%	9
2	B	1 25σ to1 75 σ	7%	8
3	C	0.75σ to 1 25σ	12%	7
4	D	0 25σ to 0 75σ	17%	6
5	E	-0 25σ to 0 25σ	20%	5
6	F	-0 75σ to −0.25σ	17%	4
7	G	-1.25σ to −0 75σ	12%	3
8	H	-1.75σ to −1 25σ	7%	2
9	I	∞ - to −1 75σ	4%	1

See fig.1 that shows normal distribution. Similarly one can decide to divide in any number of intervals. NCERT proposes 9-point scale

- Advantage of grading system are
  - One can compare the performance across two subjects/boards eliminating difference in difficulty levels
  - It is more logical to add performance on the basis of grades, rather than raw scores that are biased due to variety of reasons.
  - Overall performance can be obtained by the formula:

    $$\text{Grade point average (GPA)} = \frac{\text{SUM OF GRADE POINTS}}{\text{No. of subjects (N)}}$$

  - In order to choose students for admission, one method could be to find weighted grade point average (WGPA) using the formula:

    $$\text{WGPA} = \frac{\text{Sum of grade points + grade point of the concerned subject}}{N+1}$$

  - Calculating WGPA for different subjects, merit list could be made and seats allotted.

One could use GPA. For choosing the candidates for a particular stream, say mathematics,

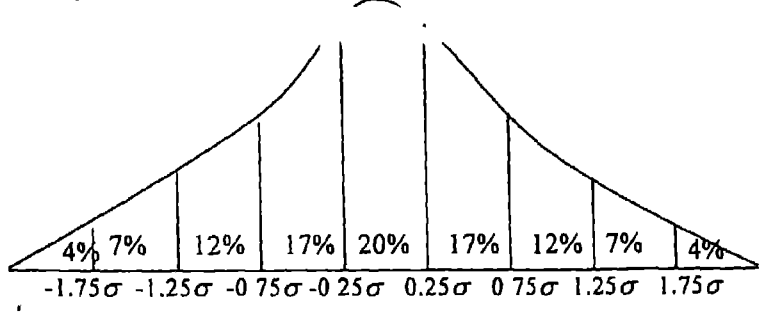


Fig. 1. Normal distribution curve showing percentage frequency in different intervals σ is standard deviation

Project (1)

Chapter: Electricity, its Heating and Chemical Effect

Concept

To study the heating effect of electric current in different materials

Planning

Class will be divided into four groups

Group A – Students of this group will collect reference material from the textbook/practical book

Group B – They will perform the experiment using cu wire

Group C – They will perform the experiment using Fe wire

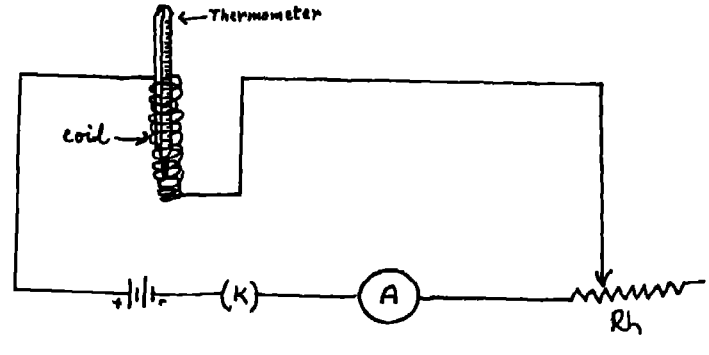
Group D – They will perform the experiment using chromium wire.

Formulation of Hypothesis

1. Heat produced in the conductor increases with the increase in current.
2. Heat produced depends upon the time for which the current is passed.
3. Heat produced depends upon the nature of materials used as conductors.

Data collection and observation

Students of different groups will go to the laboratory and perform the experiment with different types of wires as shown in the following diagram.



They will observe temperature of the thermometer when

(1) same and small amount of current is passed through different conductors for the same time.

(2) Same but larger current is allowed to pass through the conductor for the same time as in the above case.

(3) Same current is passed through all the conductors for different time

Interpretation of Data

(1) Heat produced is more when large current is passed through the conductor and it is comparatively less when low current is passed.

(2) Heat produced is more when current is passed for longer time.

(3) Heat produced in iron conductor is more as compared to that of Al or chromium

(4) Heat produced in copper conductor is least.

Conclusion

When current is passed through a conductor, heat is produced. The amount of heat produced depends upon current

(1) the amount of current

(2) the time for which current is passed.

(3) The resistance of the material, hence $H \alpha I^2 Rt$

Project (2)

Chapter – Nutrition and Respiration

Concept To study that Chlorophyll is necessary for photosynthesis

Planning:- Divide the students in four groups A, B, C, D

Group A – will be asked to keep a plant continuously in the dark for 72 hours

Group B – they will be asked to take leaf of this plant and also from a plant kept in the sun for a long time

Group C – will be asked to dip the leaves in boiling water for a few minutes to denature the enzyme

Group D – (i) will be asked to boil those leaves in alcohol

(ii) will be asked to pour hot water and then iodine on both the leaves and observe the colour.

Formulation of hypothesis:

(i) Boiling water denatures enzyme

(ii) Boiling in alcohol removes the chlorophyll

(iii) Plants make their food in the presence of sun light.

Observation and Data collection

i The boiling of leaves remove chlorophyll from it and turn them colourless

ii When iodine solution's drop poured on the Leaves of both types

iii Colour of leaf kept in sunlight turns blue. It shows the presence of starch

[illegible] brown

Conclusion:

In the end we conclude that the presence of sunlight and chlorophyll are necessary for the photosynthesis process in which food material starch is formed In the absence of light the leaves of plant can't produce starch

Project (3)

Chapter: Nature of Matter
Concept: Solution, suspension and colloids
Planning: Class will be divided into four groups

Group A-Students of this group will collect reference and physical material
Group B- They will mix 10 gm sugar with 100 cc water
Group C- They will mix 10 gm calcium carbonate with 100 cc water
Group D- They will mix 10 gm sand grain with 100 cc water

Formulation of Hypothesis:

(i) Homogeneous solution are formed by sugar and calcium carbonate in water and heterogeneous solution is formed by sand grain in water

(ii) Homogeneous solution is formed with sugar in water, heterogeneous solution is formed with calcium carbonate in water while sand- grain is not dissolved in water.

(iii) Sugar is not seen after dissolving but calcium carbonate and sand - grains are seen after dissolving

Data collection and observation: Take 100 cc water in each of the three beakers. Equal amount of sugar, calcium carbonate and sand -grains (say 10 gm) is mixed with water separately. It is observed that -

(i) sugar is completely dissolved in water
(ii) calcium carbonate is partially dissolved
(iii) sand-grains are not dissolved at all

Interpretation of data:

(i) Sugar in water forms a true solution It is homogeneous
(ii) Calcium carbonate in water forms o colloidal solution It is homogeneous looking but heterogeneous mixture.
(iii) Sand-grains in water forms suspension

Conclusion:

(i) In a true solution solutes cannot be seen by unaided eyes It is homogenous.
(ii) Colloidal solutions is not transparent The dispersed particles are very tiny It cannot be filtered
(iii) Suspension is a heterogeneous mixture of solid in liquid or gas

Project – 4

Chapter – Food, Nutrition and Health

Concept

Study of Balance Diet

Planning

The class will be divided into two groups.

Group A – Students of this group will visit slum area and will collect the data regarding their food habits.

Group B – Students of this group will visit to well-to-do families and will collect the similar data

Formulation of Hypothesis

(i) Persons of slum area would be weaker having white spots on their faces.

(ii) Persons of well-to-do families take balance diet. Therefore they would be stronger and healthy.

Testing of Hypothesis

	Group A	Group B
	Slum area	well to-do families
Observation – they eat rice and dal only		they eat rice, chapatti, dal, vegetables, fruits, sugar, milk, oil, ghees, nuts everyday

Data collection

S.No.	No of weeks	A	B
1	After one week	X	X
2.	After 2 weeks	weak	X
3.	After 3 weeks	more weak	X
4.	After 4 weeks	suffer from different diseases, some of them have white spots on their faces	healthy as before

Interpretation

From these observation it is found that people residing in slum areas are suffering from malnutrition

Conclusion

For the proper health, balance diet is necessary Grains, cereals, vegetables, fruits, oils, nuts, pulses, sugar together they form a balance diet

Project (5)

Chapter – Heat

Project Expansion and conductivity of solids

Planning

Sometimes sealed bottle oil is tightly screwed. It gets open in hot water A gap is left in between railway tracks Similarly, heat flows faster in some metals and in some others, it flows slowly.

For eg: Heat flows at different rate through Cu, Al, Fe metals etc

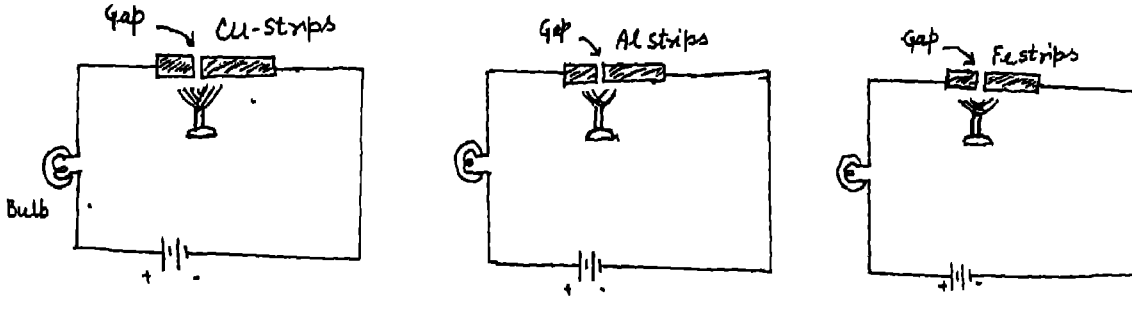
Class will be divided in three groups They will perform the experiments using copper, aluminum and iron strips respectively

Formulation of hypothesis

1) The expansion and conductivity of 'Al' may be maximum
2) The expansion and conductivity of 'Cu' may be maximum
3) The expansion and conductivity of 'Fe' may be maximum

Collection of materials Strips of Cu, Fe and Al, one each, A battery, electric bulb, heating lamp

Testing of hypothesis



Experiment A **Experiment B** **Experiment C**

Take three rods made of Cu, Al and Fe Connect them separately with electric bulb and with a battery A small gap is left between the strips. Start heating the three strips at one time

Data collection and observation:

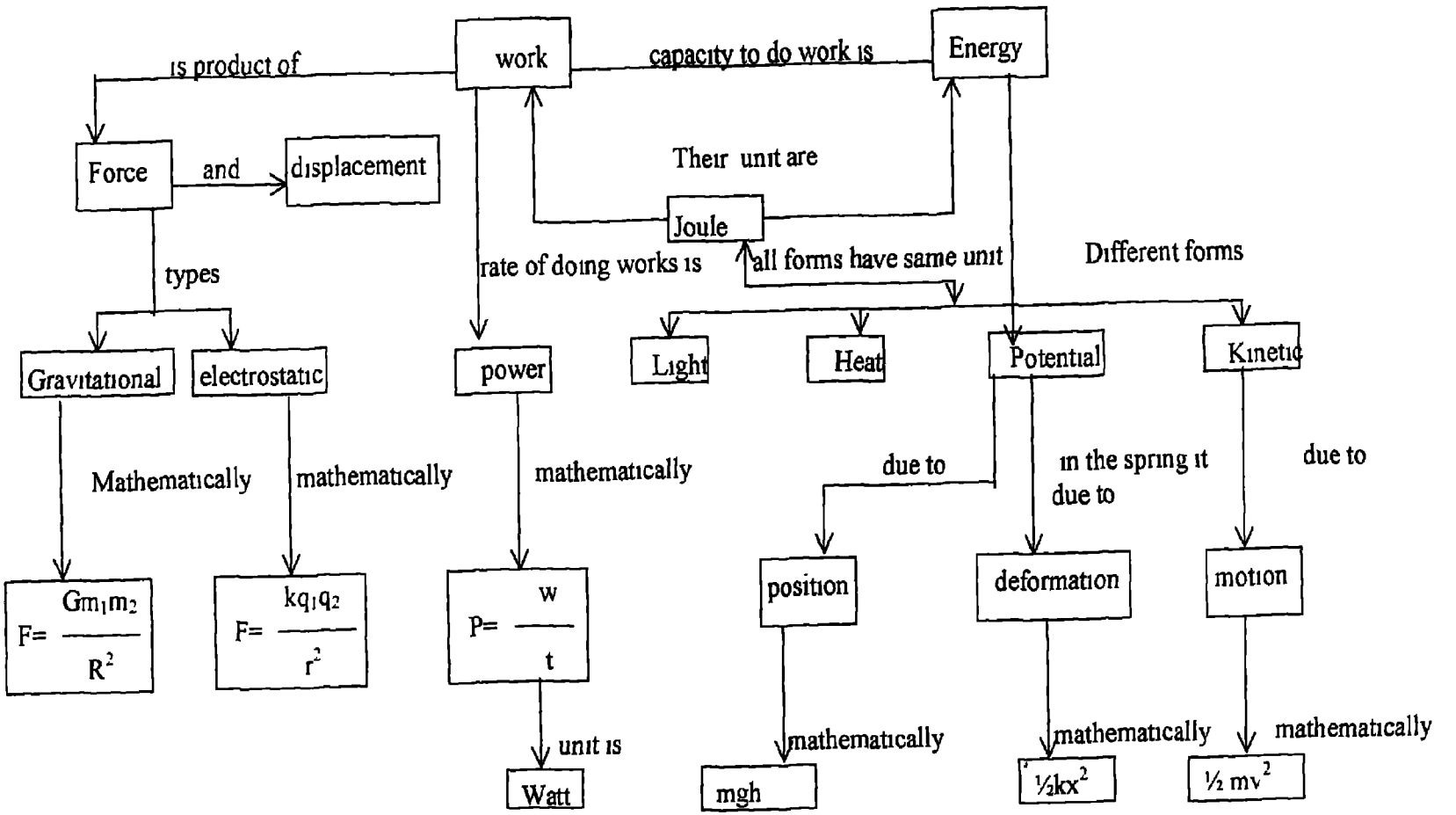
Time (minutes)	A	B	C
15	X	X	X
20	Electric bulb glows	X	X
25	Keeps glowing	Bulb glows	X
30	Keeps glowing	Keeps glowing	Bulb glows

Interpretation of data: Electric bulb connected with the copper strip will glow first. After that bulb in second experiment starts glowing and finally the bulb attached with iron strip glows

Conclusion

The expansion in the case of copper is maximum According to their thermal conductivity, three metals can be arranged as Cu > Al > Fe.

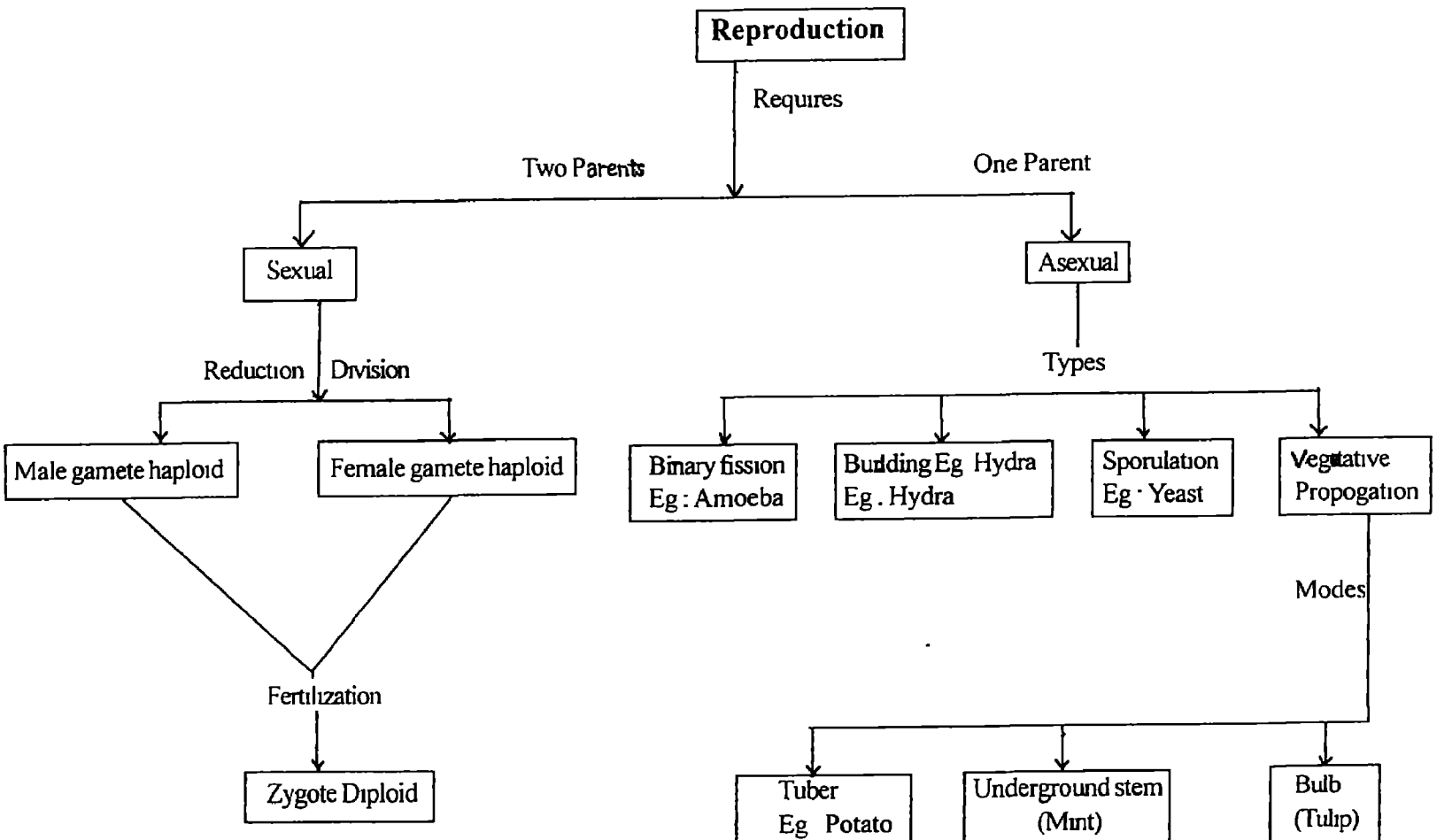
Concept Map – 1
Chapter – Work, Power and Energy
Topic – Work



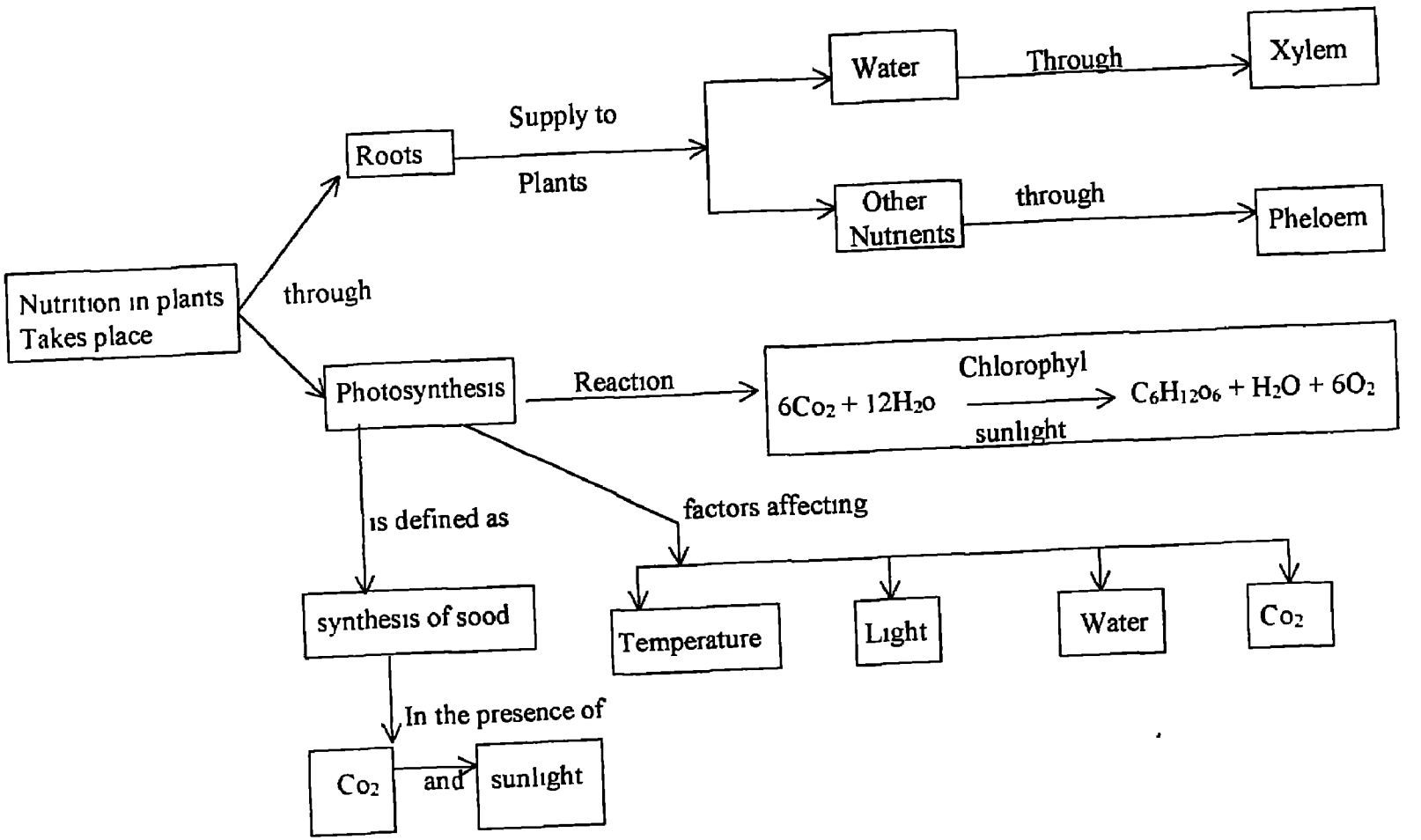
CHAPTER :- Reproduction

TOPIC :- Reproduction

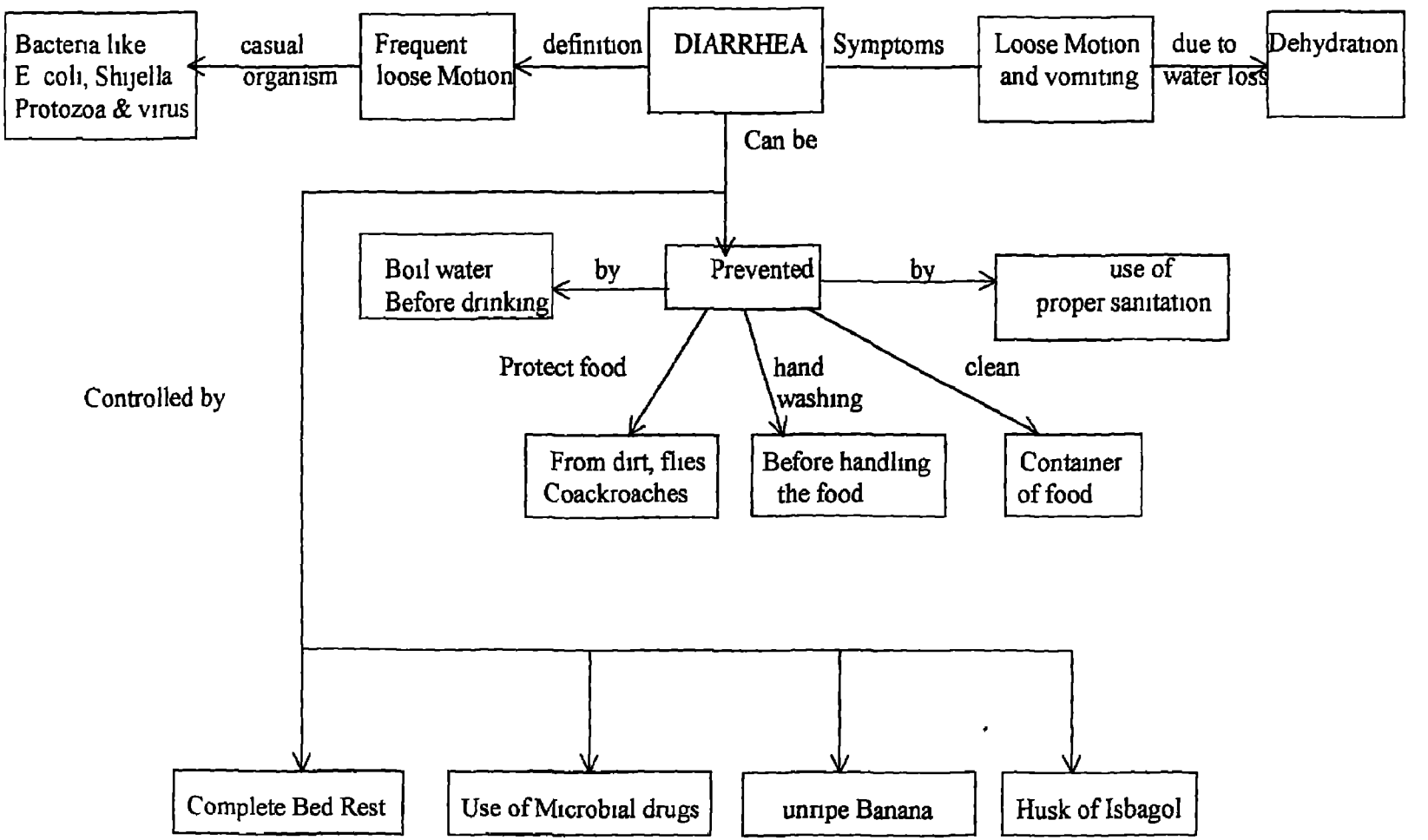
CONCEPT MAP - 2



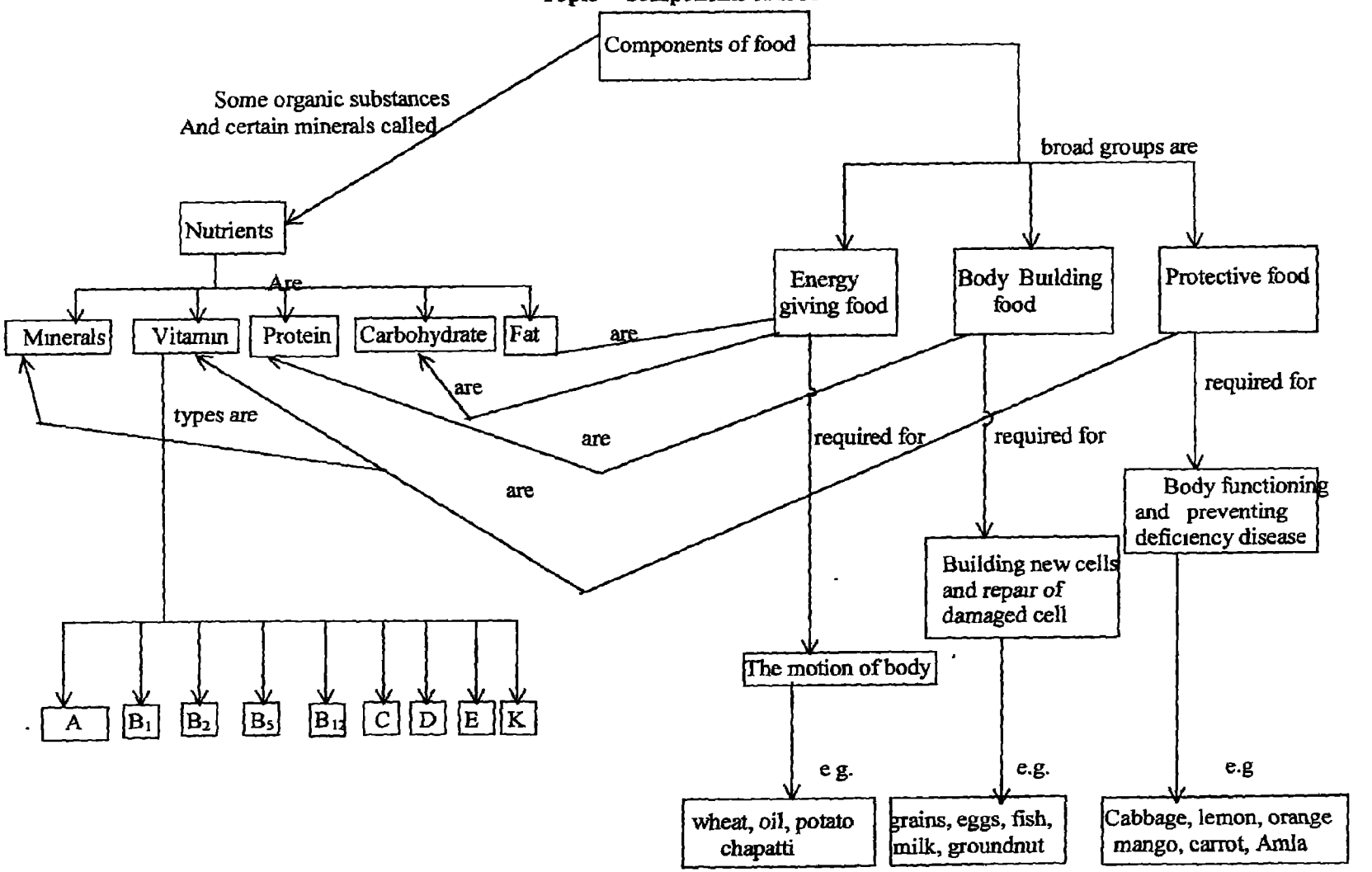
Concept - 3
Chapter – Nutrition and Respiration
Topic – Nutrition



Concept Map – 4
Chapter – Human Diseases
Topic – Diarrhea



Concept Map – 5
Chapter – Food, Nutrition and Health
Topic – Components of food



Activity – 1

Chapter – Heat

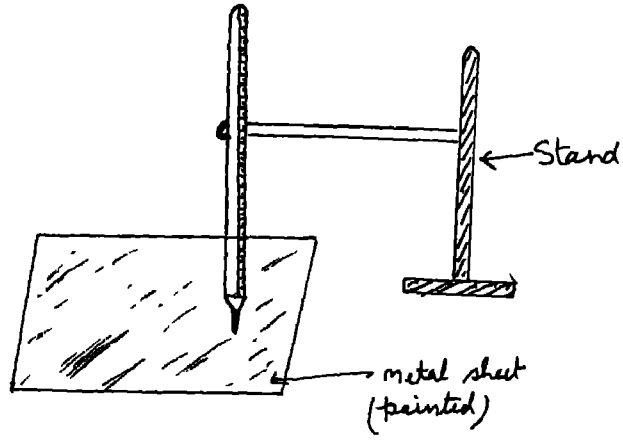
Concept – Heat absorbing capacity of different colours is different

Material required – Iron strips painted with white, black and red colours, three thermometers with stand.

Teaching points

1. To show radiations absorbed by different colours are different
2. to show black absorbs maximum radiations and white absorbs minimum radiations.

Diagram



Procedure

1. Thermometers are attached with three strips separately with the help of stands
2. Initial temperature of each of the strips are noted down
3. The strips are kept in the direct sunlight.
4. Final temperature of each strips are recorded after 30 minutes

Conclusion

1. All strips when placed in sunlight for 30 minutes show different temperatures
2. Temperature of the black maximum showing it absorbs maximum radiations falling on it.
3. Temperature of the white strip is minimum showing it absorbs minimum radiation falling on it

4 Temperature of the red strip is intermediate showing it absorbs radiations greater than white but less than black strip

Test yourself

Q 1 Which colour have maximum absorbing capacity? State the reason for it

Q.2 Which colour has minimum absorbing capacity?

Q 3 What is the reason for it?

Activity – 2

Chapter – Nutrition and Respiration

Concept - Chlorophyll is necessary for photosynthesis.

Material required: Potted plant, boiling water, alcohol, iodine

Procedure

1 Keep a potted plant in dark continuously for 72 hours
2 Now take a leaf of this plant and also a leaf from a plant kept in sunlight for long time
3 Dip both the leaves in boiling water for a few minutes to denature the enzyme.
4 Boil the leaves in alcohol. This process will remove chlorophyll and leaves will turn colourless.
5. Put the leaves in hot water to make them soft.
6 Pour a few drops of iodine solution on both the leaves and observe the colour.
7 The colour the leaf kept in the sunlight will turn blue which shows the presence of starch
8. The leaf that was kept in dark becomes brown

Conclusion

Chlorophyll is necessary for the production of starch by photosynthesis

Test yourself

Q 1. Name the factors which effect the process of photosynthesis
Q.2. What are the conditions under which starch is formed in the plants?
Q 3 What is indicated by the presence of starch in the leaves?

Activity – 3

Chapter - Rate of Chemical Reaction and Chemical Equilibrium

Concept - Ignition temperature

Apparatus/Material required - 10 ml alcohol, 10 ml of water, a piece of cotton cloth, candle, match box

Objective – To show that certain temperature is required by the substance before it burns

Procedure

1 Take 10 ml of alcohol
2 Add equal amount of water to it
3 Dip the piece of cloth into this mixture.
4. Burn a candle with match box
5. Take the cloth towards the lighted candle
6 Observe the burning of cloth
7 The fire around the cloth extinguishes after some time without burning it

Conclusion

After performing the above experiment we find that certain specific temperature is required by the substance before it burn This temperature is known as ignition temperature.

Test yourself

Q 1 Why the piece of cloth did not burn?
Q 2. Why substances burn at a particular temperature?
Q 3. What do we call this temperature?
Q.4 What is its definition?

Activity – 4

Chapter - Food, Nutrition and Health

Concept - Carbohydrates as the component of food.

Material/Apparatus required – Starch (potato), sugar (bananas, lemon), boiled eggs, test tubes, iodine solution, Benedict's solution.

Teaching Points

1 Carbohydrates are present in different types of food.
2 Examples of carbohydrates are starch sugar, glucose, cereals, roots and tubers.

Procedure – Test of presence of carbohydrates

a) Starch Take a small piece of potato and place in a test tube Then, add a drop of iodine solution to it you will notice that colour of solution of turn blue-black. It indicates the presence of starch

b) Take a small piece of boiled egg white and repeat the experiment Absence of blue-black colour shows the absence of starch in egg white

c) Take a small piece of banana, potato and lemon Crush them separately and strain the juice Put 5 to 10 drops of juice in different test tubes and add a few drops of Benedict's solution to each and heat

Note the colour before and after the addition That which changes to radish orange colour contains sugar

Conclusion

Potato has starch in it, while boiled egg white has no starch

Test yourself

Q.1 What are the different types of carbohydrates?
Q 2 What are the major sources of carbohydrates?
Q 3. Name the major nutrients present in rice?
Q 4 How will you test the presence of carbohydrates in a food item?

Activity – 5

Chapter - Magnetic Effect of Electric Current
Concept - Electromagnetic Induction
Material/Apparatus required – Magnet, Galvanometer, a coil of conducting wire.
Objective

1 To show the phenomenon of EMI

Procedure

1. Take a coil of wire having a no of turns (say 20)
2 Connect the coil to the galvanometer Take a bar magnetic and move it towards the coil with speed
3. Observe that when the N-pole of magnet is moving towards the coil, the galvanometer shows the deflection in one direction This deflection indicates that current is set up in the coil

4 When N-pole moves away from the coil, the galvanometer shows deflection in opposite direction

5 The same effects are observed when the coil is moved away or towards the stationary magnet

6 When both magnet and coil are stationary, there is no deflection in the galvanometer

Conclusion

Induced current is produced whenever the magnetic flux linked with the coil changes

Test yourself

Q.1 What is EMI?

Q.2 Why is induced current produced?

Q 3 How is induced current produced?

Q 4 What is the condition under which induced current is produced?

APPROACH PAPER
(PAC 15.31)

Training of KRPs on Methodology of Teaching Science with Special Emphasis on Physics at Secondary Level for Himachal Pradesh

Teaching is a planned and systematic organisation of action, which is directed towards bringing desirable modification in the behaviour of the learner This change can be brought by proper use of a particular method of teaching in any teaching-learning situation Achievement of maximum performance of the learner and harnessing his optimum potential depends on the methodology adopted by the teacher Emphasizing on the proper instructional strategy, National Curriculum Framework For School Education (2000) has stated. "For effective transaction of the curriculum and achievement of curricular objectives, appropriate strategies should be used in organizing activities for students and in providing learning activities for students". Thus objective of teaching science is not only to transact the content as such, but also to help the students acquire the skills in using the method and process of Science Education in science gives an individual a dynamic awareness of his environment

A lesson on Science may include more than one approach of teaching as certain approached are more effective in realizing specific type of instructional objectives and different methods may be interwoven into the lesson. Therefore it is of utmost importance for the science teacher to acquaint himself with various methodologies and criteria of selection of a specific methodology in terms of their effectiveness and achievement of various instructional objectives As George W Hunter has put it "A given

method which to one teacher may be of great value may lose much of its value in the hands of another teacher, especially if that teacher believes that a different method is better".

Implementing a suitable method in a proper way quickly captures the attention and interest of the students in a manner that is consistent with the pursuit of science but it also arouses, stirs and awaken higher level of reflective thinking

Thus, it is imperative for a science teacher to acquaint himself with different methodologies, strategies and tactics of teaching. He must be able to exploit the potentialities of different methods of teaching science and in similar view recognise its limitations so as not to allow them to unknowingly set limits to his efficiency or learning capability of his students.

It is in this backdrop, the present programme has been undertaken

Objective

1. To identify the difficult concepts from the curriculum.
2. To develop transactional methodology for teaching the above topics
3. to develop training package and instructional material for dealing with the misconceptions.
4. To impart training in performing practicals and projects.

Methodology

Training is to be imparted in dealing with the methodologies of teaching difficult concepts of science in various teaching learning situations with special emphasis on Physics.

In house meeting of the faculty members of the programme team was held to identify the difficult concepts of the curriculum Different methodologies and strategies for the transaction of the hard spots of science was developed through group discussion and brain storming session Training package has been prepared by the resource team for training science teachers, teaching secondary classes of Himachal Pradesh

This package consists of instructional material on a variety of methodologies of teaching science that would facilitate learning in an organised manner and develop critical and independent thinking among learners

In addition to lecture sessions, training will be provided in the basic processes and skills involved in the experimental work. Some of the activities will be suggested to promote better learning environment. Teachers will be exposed to the use of computer multimedia as well for enhancing the effectiveness of learning. KRPs will be motivated to develop activities for bringing desirable change in the behaviour of the learner and simultaneous realization of cognitive, affective and psychomotor objectives. They will be assigned to develop teaching modules involving various methodologies through group work.

Regional Institute of Education, Ajmer

Time -Table

Training of KRPs on Methodology of Teaching Science with special emphasis on Physics at Secondary level for Himachal Pradesh (15th Jan. to 19h Jan. 2004)

Day and Date	Time	Subject
Thursday	9.00 – 9.30 a.m.	Registration
15.1.04	9.30-10.00 a.m.	Inauguration
	10.00-11.00 a.m.	Grading & Evaluation (ABS)
	11.15 – 1.00 p.m.	Nuclear Fission and Fusion (SP)
	2.00 – 3.45 p.m.	Group Work (SP)
	4.00 – 5.30 p.m.	Use of computer in teaching 'Universe' (SKP)
Friday	9.00 – 11.00 a.m.	Rate of Chemical Reaction (SCB)
16.1.04	11.15 – 1.00 p.m.	Wave Motion (HCJ)
	2.00 – 3.45 p.m.	Group Work (SP, SCB)
	4.00 – 5.30 p.m.	Chemistry Practical
Saturday	9.00 – 11.00 a.m.	Reflection, Refraction and Optical
17.1.04		Instruments (SVS)
	11.15 – 1.00 p.m.	Force and Motion (ABS)
	2.00 – 3.30 p.m.	Group Work (SP, AKM)
	4.00 – 5.30 p.m.	Physics Practical (SP, HCJ)
Sunday	9.00 – 11.00 a.m.	Work, Power and Energy
18.1.04		and Gravitation(KCS)
	11.15 – 1.00 p.m.	Heat (VPA)
	2.00 – 3.45 p.m.	Presentation of Group Work by Participants
	4.00 – 5.30 p.m.	Physics Practical (SVS, VPA)
Monday	9.00 – 11.00 a.m.	Our Environment (AKM)
19.1.04	11.15 – 1.00 p.m.	Electricity and its effects (SKP)
	2.00 – 3.45 p.m.	Biology Practical
	4.00 – 5.30 p.m.	Valedictory

Regional Institute of Education, Ajmer

The following persons attended the programme entitled "**Training of KRPs On Methodology of Teaching Science with Special Emphasis on Physics at Secondary Level for Himachal Pradesh**" held at Regional Institute of Education, Ajmer from **15th –19th January, 2004.**

S No	Name & designation of the participant	Address
1	Rohit Sauhta	G S S S , Jubbal, Distt Shimla (H P)
2	Bharat Bhushan	G S S S Krishan Nagr, Distt Kangra (H P)
3	Devinder Singh	G S S S, Baldwara,Distt Mandi (H P)
4	Gulshan Mahajan	G S S S, Katrain, Distt Kullu (H P)
5	Rakesh Jaswal	G S S S, Saloh, Distt Una (H P)
6	Ravinder Kumar	G S S S, Kanam, Distt Kinnaur (H P)
7	Jaipal Singh	G.S S S, Chowari, Distt. Chamba (H.P)
8	Ashok Kumar	G S S S, Nichar, Distt Kinnaur (H P)
9	Dharma Veer	G S S.S, Panjgain, Distt. Bilaspur (H P.)
10	Rajesh Kumar	G (B) S S S, Nalagarh, Distt Solan (H P)
11	Ramswaroop Gautam	G S S S, Chandi, Distt Solan (H p)
12	Sanjay Kumar Gupta	SCERT, Solan (H P.)
13	Hit Dev Sharma	SCERT, Solan (H P)
14	Ramesh Kumar Thakur	G.S S S, Sandhole, Distt mandi (H P)
15	Brij Lal Sharma	G S S S, Wahan, Distt. Bilaspur (H P)
16	Hoshiar Singh Rana	G S S S, Sujanpur Tihra, Distt Hamirpur (H.P)
17	Vikramjeet Sharma	G S S S, Dhameta,Distt Kangra (H P)
18	Anil Kumar Katoch	G.S S S, Indora, Distt Kngra (H P)
19	Chander Pal	G S S S, Sangarh, Distt Sirmour (H P)
20	Banwari Lal	G.S S S, Naina tikker, via-Kumarhatti, Distt Sirmur (H P.)
21	Sanjay Kumar Mehta	G S S S, Laldani, Distt Shimla (H.P)
22	Anil Kumar Azad	G S.S S, Bagli,Distt Kangra (H P)
23	Sandeep Dogra	G S S S., Jalag , Distt. Kangra (H P)
24	Ravi Prakash	G S S.S , Theog, Distt Shimla (H.P)